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An observational method for studying classroom cognitive processes

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AN OBSERVATIONAL METHOD FOR STUDYING CLASSROOM COGNITIVE PROCESSES

by

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF TABLES

INTRODUCTION

Scope of the Research

The primary purpose of this study is to develop and test a method for observing and recording one kind of classroom interaction between teachers and students. Verbal teaching behaviors that may stimulate students' cognitive responses and the responses that students make as a result of the stimulation by the teacher are the focus of the observational and recording system. A secondary purpose of this study is to suggest ways of applying the observational and recording method in teacher education activities at pre-service and in-service levels.

Traditionally the phrase, cognitive behaviors, has been applied to include all intellectual processes. Bloom (c1956) defines behaviors occurring in the cognitive domain as those related to "... the recall or recognition of knowledge and the development of intellectual abilities and skills" (p. 7). Cognition is defined in the Dictionary of Education (Good, c1959) as:

> (1) the faculty of knowing, especially as distinguished from feeling and willing; (2) the act of gaining knowledge or becoming acquainted with an object through personal experience; (3) knowledge that extends beyond mere awareness (p. 107).

In the same dictionary, cognitive intelligence is interpreted as "... that mental functioning involved in perceiving, knowing, and understanding ..." (p. 293).

Specific objectives for achieving the purposes of the research are to:

A. Develop an observational instrument for use with home economics teachers in the analysis of teaching behaviors that stimulate student cognitive responses.

B. Determine the inter-observer reliability in reporting the observed components of the teaching behaviors.

C. Extend the method for analyzing teaching behaviors so that it can also be used in the analysis of responses of students to these teaching behaviors.

D. Study and refine, as needed, the method for observing and recording behaviors of teachers and their students.

E. Test the observational and recording method for analyzing teacher-pupil cognitive interaction in the classroom in three ways.

1. Study inter-observer and intra-observer reliability.
2. Categorize cognitive behaviors in home economics classrooms as displayed on videotapes.
3. Study the data supplied by the categorization of behaviors to determine:
   a) levels and total number of behaviors exhibited;
   b) relationships between behaviors of teachers and students;
   c) ability of the method to discriminate among classrooms.

Background for the Research

Much of the research in teaching prior to the 1950's was directed toward the outcomes of the teaching process, the actual learning achieved by students (Gallagher and Aschner, 1963) or toward manipulating variables in artificial situations. Little emphasis was given to identifying actual teaching techniques or processes which resulted in these student learnings.

Research in the 1950's reflected the need for a better understanding of the teaching-learning process and for identifying the effective teacher.

However, investigations that attempted to make overall judgments or global assessments concerning teaching were not very productive in predicting teacher effectiveness. A better understanding of the teaching-learning process was also hindered by disagreement among various judges in reporting what they observed in classrooms. The major reason for this disagreement was the lack of objective, clearly defined criteria upon which judges could base their observations.

Studies conducted in the 1960's suggested that studying selected teaching behaviors rather than attempting to generalize about total teaching situations could lead to a better understanding of the relationships existing between the teaching process and desirable behavioral change in learners. To make these observations of selected behaviors as useful and as objective as possible, various systems for observing and analyzing classroom behaviors were developed. A review of several of these systems is given by Kalbfleisch (1967).

Investigators who attempted to use these observational instruments for obtaining a better understanding of the teaching-learning process were often hampered by practical problems. The limitations of time and money, the resentment of teachers toward invasion of their privacy, the effect of an observer's presence upon teaching behavior, and the feeling that such a study could not successfully increase knowledge of the teaching process were given as examples of these practical problems (Medley and Mitzel, 1963).

Need for the Research

Two areas of educational concern are related to this study. The first of these is the need for a better understanding of the general teaching-learning process which is necessary if the education of teachers and the actual teaching are to be more effective. A major interest of educators involved in the preparation of teachers is the identification of behaviors and characteristics of teachers which contribute to good teaching and result in desirable learning on the part of students. One of the most fruitful approaches for identifying behaviors seems to be the development and use of various instruments for observing, recording, and analyzing these behaviors. A consensus concerning good teaching and desirable learning seems more attainable if all concerned are talking about the same behaviors and are using the same terminology.

The second area of educational concern related to this study is the need for a better understanding of specific teaching-learning processes in the cognitive domain which, if occurring at the higher cognitive levels, lead to the development of concepts and the formation of generalizations. Results of classroom observations have hinted that teachers stimulate or provoke a disproportionate number of lower-level cognitive processes in students such as the recall of facts or experiences. More complex behaviors related to evaluation, to the application of knowledge, and to creative problem solving need to be stimulated in classroom discourse. Teachers who might use the observational and recording method developed in this study for analyzing their own classroom cognitive behaviors will have a basis for changing and improving the level of cognitive skills they are stimulating in students.

Observational systems dealing with the cognitive domain have recently been developed (Simon and Boyer, 1968) but these systems often attempt only to note the occurrence of general thought processes and fail to analyze the structure or quality of these processes. In comparison to the affective area of classroom interaction the cognitive area has not yet received the attention of researchers that is needed to reach the level of understanding required for greatest usefulness. This may be because educational investigators do not yet perceive of the cognitive domain as worthy of concern. It may be that educators interested in classroom interaction are still more influenced by an educational philosophy which emphasized the affective behaviors occurring in the classroom or which emphasized only the lower level cognitive behaviors of rote learning, memorization, and the acquisition of large amounts of knowledge. It may be that lack of an adequate theory upon which to base research concerning cognitive processes is a hindrance to the development of observational instruments for analyzing cognitive behaviors.

THEORY AND RESEARCH IN COGNITIVE PROCESSES

Introduction

In the historical development of classroom interaction research definitions of teaching and of the effectiveness of teachers first held the interest of educators. These early definitions of teaching and of behaviors and characteristics of effective teachers were broad and comprehensive and provided few bases for improving teaching. Attempts were next made to describe effective teaching by focusing on the outcomes of the teaching, pupil performance or behavioral change. This basic research design did not indicate the teaching behaviors leading to the various learning results. Withall (1960) said:

> It is astonishing and discouraging, as one examines the research of the past and the near-present, to discover how little attention, relatively, has been paid to the major variables in the teaching-learning process -- the teacher, the learner, and teacher-learner interaction (p. 497).

More recent research efforts to arrive at statements concerning relationships between teaching and learning were unproductive because they focused on very general behaviors. Again, few bases were provided for improving the teaching-learning process.

Because of these unfruitful historical developments the current emphasis in the area of classroom interaction in educational research is on specific and well-defined behaviors of teachers and pupils as they are exhibited in the natural setting of the classroom. Analytical techniques for observing and describing these behaviors have been developed by such researchers as Amidon and Hunter (1967), Bellack et al. (c1966), Flanders (1962), Hughes (1962), Medley and Mitzel (1958), Smith (1960), and Withall

(1949) and additionally, by Brown (1969), Gallagher and Aschner (1963) and Hunkins (1968). The variation in these techniques is almost as great as their number. Simon and Boyer (1968) have conveniently presented many of these techniques in Mirrors for Behavior: An Anthology of Classroom Observation Instruments. Gallagher (1968) summarizes the faith being placed in this research approach in the following statement:

> The most significant trend in recent educational research has been to abandon the study of characteristics of students and/or teachers and to begin a more effective analysis of the behavioral interaction of these individuals in the classroom setting. It is through analyses of these complex interacting behavior patterns that one may at last reach the "Holy Grail" of "teacher effectiveness" that has so far eluded the educational investigator (p. 3).

Many of the earlier observational instruments, notably those designed by Withall (1949) and by Flanders (1962), focused on affective aspects of classrooms. Reasons for neglecting behaviors in the cognitive domain in observational instruments have been given in the introductory chapter of this dissertation. Crutchfield (1969) further discusses two assumptions that may have led researchers to ignore these cognitive behaviors and states why he believes these assumptions are unacceptable:

> Underlying this comparative neglect of the training of thinking skills seem to be at least two implicit assumptions, both ill-founded and mutually incompatible. One view is that these skills cannot be trained. The other view is that they do not need to be trained. The first view -- that productive thinking and problem solving are simply not trainable -- is based on the assumption that the marked individual differences found at all ages in ability to think and solve problems are a function of basic intellectual abilities of a deep-seated kind not readily susceptible to modification. There is gradually accumulating evidence that this assumption is wrong. A number of quite different approaches are showing success in direct attempts to facilitate the productive thinking and problem-solving performance of students at all ability levels ....
>
> The second view -- that the highly advanced skills of productive thinking and problem solving do not require direct training -- is

> based on the assumption that they will more or less automatically develop as the student learns more and more subject matter; in short, the higher-level cognitive skills are assumed to be merely an extension and elaboration and adding together of the simpler cognitive skills. It is very doubtful that this assumption is correct. There seems no good reason to suppose that the higher-level mental skills can be counted on to emerge automatically out of the simpler ones. Productive thinking and problem solving are complex processes which require direct attention in and of themselves. They are not just the additive end products of simpler cognitive processes.
>
> Indeed, the view we present here is quite the opposite: In their fullest sense, all cognitive skills, even the simplest of the skills of acquiring information, are properly to be conceived of as integral parts of the more general processes of productive thinking. Productive thinking should not be conceived of as something special, rarefied, and removed from the usual mental activity of the individual. It is what goes on, or should go on, whenever the individual is engaged in cognitive work. And that is true equally of the young child and the mature student (p. 54).

Another reason for emphasis in the development of observational instruments being first focused on affective behaviors may be derived from the following statement by Withall (1960):

> ... the most viable instructional setting is one in which both the individual's self-development goals and content-mastery goals are attained. They emphasize, moreover, that the individual's self-needs must be met before progress can be made in content mastery (p. 500).

Teaching properly emphasizes both the affective and cognitive aspects of classroom interaction. Research attention and instrument development have recently centered on cognitive skills as they are related to teaching and learning. The importance of the need for educational attention to the cognitive aspects of teaching and learning are discussed by an Ohio Education Association Committee for Instruction and Curriculum (Dull, 1964):

> Children and youth today have greater need than at any time in history to learn how to do critical thinking. Knowledge is now doubling every decade. Therefore, school pupils cannot be expected to learn all the information that might be important to learn. Furthermore, because of rapid changes many facts of one

> period of time are no longer facts a later period of time. With these existing circumstances we must spend more time in our elementary and secondary schools in teaching pupils how to think rather than spending so much time, as we have in the past, in memorizing facts and in rote learning (p. 5).

Davis et al. (1969) give some possible explanations for the recent interest in studying classroom cognitive behaviors:

1. Because of advancing technology there has been "... mid-century attention directed toward intellectual achievements" (p. 713).

2. As already discussed, there has been a "... resurgence of interest in the direct study of teaching" (p. 713).

3. There has been "... substantial progress, both theoretical and practical, in the analysis of cognitive operations" (p. 713). Guilford (1956) and Bloom (c1956), for example, have developed theoretical definitions of the higher intellectual processes which go beyond the meaning of the terms "thought", "critical thinking", or "higher mental processes".

The third explanation, the progress in cognitive theory, may well be the most important development for research in this area. If observation systems are to be objective, valid, and reliable for improving the teaching-learning process they should have reference to some theoretical framework. The value of theoretical statements may also be studied during instrument development. Therefore, an important reciprocal relationship exists between theory and application. Newell and Brown (1969) state that:

> ... no observational system can possibly record all, or even most, classroom behaviors at the same time. Selections must be made. There must be some basis for making decisions about which items of behavior to include or exclude. Such a basis, like it or not, good or bad, explicit or implicit, represents a theoretical point of view (p. 5).

The next section of this chapter contains a description of the cogni-

tive theories providing the most direct theoretical bases for this research effort. These are the theories of Guilford, Bloom, and Faculty of William M. Stewart School. Other theories not so directly related, but discussed first, are those of Bales, Taba, Woodruff, and Smith. The section of the chapter following cognitive theories deals with observational systems developed from the theories of Guilford and Bloom and uses made of the observational systems in research.

Relevant Cognitive Theories and Classifications

An understanding of the terminology needs to precede a discussion of various cognitive theories. The word, cognition, and the phrase, cognitive intelligence, have been defined in the introductory chapter of this dissertation. A definition very similar to that of Bloom is provided by Gage (1966) for the word, cognitive:

> Here I refer to those aspects of teaching that are directly concerned with furthering the learner's achievement of the so-called cognitive objectives of education, as distinguished from affective or psychomotor objectives. The cognitive objectives are various kinds of knowledge -- defined as ability to recall or recognize facts, definitions, laws, and so on -- and various kinds of intellectual acts and skills, such as ability to analyze, evaluate, synthesize, translate, interpret, and so on (p. 30).

Theory is defined by Good (c1959) as:

> ... an assigned system of related conceptions found through experience to be in agreement with known properties or behaviors and stated so as to guide in the search for properties or behaviors hitherto unknown ... (p. 568).

The sub-title given to this section, cognitive theory, is defined by Theus (1968):

> Cognitive theory deals with the problem of how people gain an understanding of themselves and their environments and how, using their cognitions, they act in relation to their environments (p. 501).

The definition of Theus should be kept in mind as the various cognitive theories are discussed for these theories are precisely what Theus sees them to be, various approaches to answering the question of how people learn about themselves and their world and how they learn about the way to interact with this world.

System of Bales

A system developed by Bales (c1950) is one of the first to appear. His system consists of three categories which he applies in analyzing questions asked by an individual, not necessarily a teacher, in a group situation. These three categories are descriptive of the verbal behaviors used by an individual in attempting to increase his cognitive abilities. The discussion of the categories by Bales (c1950, pp. 186-188) is condensed as follows:

Category one: asks for orientation, information, repetition, and confirmation.

Category two: asks for opinion, evaluation, analysis, expression of feeling.

Category three: asks for suggestion, direction, possible ways of action.

It may be that this category system only describes how a person adds to his store of facts and knowledge, a very low-level part of cognitive processes described in many other theories.

Theory of Woodruff

Woodruff (1964, 1967), an educational psychologist, provides another view of cognitive process. He outlines a cognitive learning cycle related

to the formation, use and evaluation of concepts. These operations take the following form (1967):

a. A meaningful input from the environmental world through the sensory organs. (Perception.)
b. Internal storage, interpretation, and organization of the sensory input. (Thinking, and the formation of concepts, and other internal mediating variables.)
c. Use of the stored and organized meanings to mediate reaction to subsequent situations. (Decision making: selection of a line of response to a situation.)
d. An adjustive behavioral output. (The attempted execution of the selected line of response.)
e. A fresh perceptual input in the form of feed-back from the perceived consequences of the attempted adjustive action. (Empirical reinforcement or modification.) (p. 5).

In the later paper (1967), where he uses the terminology "The Human Cognitive-affective Cycle" (p. 6), he states that this model of behavior illustrates how concepts are formed in the out-of-school environment. "The school environment interferes seriously with the operation of the full cycle and thus rarely succeeds in shaping the non-school behavior of students" (p. 5). Formal patterns of teaching need to activate the full cycle of behavior "... but do it with greater purpose, selectivity, and effectiveness than random out-of-school behavior" (p. 6). Although the conceptual framework of cognition presented by Woodruff is only indirectly related to the present research, his comments concerning the relationship of formal education to cognitive processes very likely apply to all theories and research in cognition.

Theory of Taba

A third and frequently cited concept of cognitive processes is provided first by Taba and Elzey (1964) and in a slightly modified form by Taba (1965). The theoretical system is developed to help present social

studies curricula in elementary and secondary schools with an understanding of the levels of conceptual classroom discussion involved.

> In an effort to arrive at teachable and learnable aspects of thought, three cognitive tasks were identified: 1) concept formation, 2) the development of generalizations and inferences through interpretation of raw data, and 3) the explanation and prediction of new phenomena by applying known principles and facts (Taba, 1965, p. 536).

The theory of Taba differs from most others because it begins with concept formation as the first cognitive process and ignores the processes of obtaining and understanding new information and perceptions that are usually included in other theories. However, the following quotations do indicate similarities to the higher-level processes of other theories (Taba, 1965).

> Concept formation. In its simplest form, concept development may be described as consisting of three processes or operations. One is the differentiation of the properties or characteristics of objects and events ....
>
> The second process is that of grouping. This process calls for abstracting certain common characteristics in an array of dissimilar objects or events and for grouping these on the basis of this similar property ....
>
> The third process is that of categorizing and labeling. This process calls for the discovery of categories or labels which encompass and organize diverse objects and events ....
>
> In classrooms this cognitive task occurs in the form of enumerating or listing ... then grouping similar things, and finally, labeling the groups.

> Interpretation of data and inference. Essentially this cognitive task consists of evolving generalizations and principles from an analysis of concrete data. Several sub-processes are involved. The first and the simplest is that of identifying specific items or events .... This process also involves relating the points of information to each other to enlarge their meaning and to establish relationships.
>
> The third operation is that of forming inferences which go beyond that which is directly given ....
>
> Interpretation of data and formulation of inferences takes place in the classroom whenever the students must cope with raw data of one sort or another ....

> Application of principles. A third cognitive task is that of applying known principles and facts to explain new phenomena

> or to predict consequences from known conditions ....
>
> This cognitive task requires essentially two different operations. One is that of predicting and hypothesizing. This process requires an analysis of the problem and of the conditions in order to determine which facts and principles are relevant and which are not. Second is that of developing informational or logical parameters which constitute the causal links between the conditions and the prediction and, in fact, make a rational prediction or explanation possible (pp. 536-537).

Theory of Smith

A conceptual theory of teaching developed by Smith (1960, 1963) is often classified as cognitive in nature. This classification is correct although the applicability of the theory to the present research is very limited.

A teaching cycle consists of a teacher's perception of pupil behavior, diagnosis of that behavior, and action in view of the diagnosis; the student then repeats the steps of perception, diagnosis and reaction. These instances of teacher-pupil interaction are repeated in cyclical form until the ultimate goal of achievement is reached. The segment of the teaching cycle most relevant to this research is the action taken by the teacher. These action behaviors, described by Smith (1960) as the independent variables of the pedagogical model or cycle, include: 1) linguistic behavior, 2) performative behavior (demonstrations or motor performances), and 3) expressive behavior (unpurposeful non-verbal behaviors such as body posture or voice tone). In this review of cognitive theories, attention is further narrowed to one of these independent variables of the pedagogical model, the linguistic behaviors. Smith discusses three sorts of classroom actions performed with language: 1) logically relevant tasks, 2) directive action, and 3) admonitory acts. One of these three linguistic behaviors, the

logically relevant tasks, is primarily cognitive in nature.

To recapitulate: cognitive processes are involved in logically relevant tasks; logically relevant tasks are one kind of classroom actions performed by linguistic behaviors; linguistic behaviors are one kind of independent variable; the independent variables are the acts of teaching which are part of the perceiving-diagnosing-acting cycle of classroom interaction.

Now that the position of cognitive processes within the theory of Smith has been established, kinds of actions seen as being logically relevant are described. These are tasks or ventures performed by the teacher which vary according to the cognitive intent of the teacher. Smith does not explicitly state the role of students in relation to these tasks although he does say that they also perform linguistic behaviors in reacting to the teaching behaviors. Therefore, it may be that students perform logically relevant tasks of a similar cognitive nature.

Some logically relevant tasks found in linguistic behavior include (Smith, 1960): 1) defining words, 2) classifying things into categories which includes specifying the criteria used in classifying, 3) explaining or accounting for a particular state of affairs, 4) conditional inferring where "... a set of conditions is described and the teacher then gives the consequent -- the effect, result, or outcome" (p. 237), 5) comparing and contrasting, 6) valuating or rating "... some object, expression, event, or action ..." (p. 238), 7) designating or identifying objects with a word, name or symbol, and 8) other actions less nearly related to operations of logic. No hierarchy is implied by Smith nor does he make clear whether a teacher actually performs these processes mentally or is merely recalling information in these seven forms. The primary value of this system may be

in using the terminology for developing more definitive theories.

Theory of Guilford

J. P. Guilford is well-known for his theory concerning the structure of intellect. In defense of his belief that intelligence is much more than the ability to think he has developed a parametric model of intellect that identifies the various factors involved. Guilford (1956) developed his theory of the structure of human adult intellect by factor analysis. Certain unitary abilities or factors were hypothesized and appropriate psychological tests were given to show whether the factor did or did not exist. The factors seemed to differ from each other in three ways: 1) the kind of mental operation involved, 2) the content or material being dealt with and 3) the product or outcome (Guilford, 1960). These three kinds of factors form the parameters of a theoretical model which is depicted along three planes of a cube to show that the parameters are interrelated.

The kind of content or information with which a person is able to deal, be it concrete, abstract or semantic, is important to the entire process of problem solving. However, the parameter most directly related to cognitive processes is that of operations, variously described by Guilford (1960, p. 6) as "intellectual operations", "mental operations", and "thinking operations".

Guilford (1956) sub-divides his operations of thinking into five categories: 1) cognition, 2) memory, 3) divergent production, 4) convergent production and 5) evaluation. He describes or classifies them as follows:

> Inspection of the total list shows that the intellectual factors fall into two major groups -- thinking and memory factors. The great majority of them can be regarded as thinking factors. Within this group, a three-fold division appears -- cognition

> (discovery) factors, production factors and evaluation factors. The production group can be significantly subdivided into a class of convergent-thinking abilities and a class of divergent-thinking abilities (p. 268).

Guilford (1959) gives definitions for each of these categories:

> Cognition means discovery or rediscovery or recognition. Memory means retention of what is cognized. Two kinds of productive-thinking operations generate new information from known information and remembered information. In divergent-thinking operations we think in different directions, sometimes searching, sometimes seeking variety. In convergent thinking the information leads to one right answer or to a recognized best or conventional answer. In evaluation we reach decisions as to goodness, correctness, suitability, or adequacy of what we know, what we remember, and what we produce in productive thinking (p. 470).

Clarification for interpreting Guilford's use of the words, cognitive or cognition, as one kind of thinking operation needs to be made to avoid confusion when discussing Bloom and when using the word in other contexts. Guilford (c1967) makes the following comments:

> In adopting this label for the category, a very apt and descriptive one for the purpose, it was realized that reference has traditionally been made to <u>cognitive abilities</u>, a term that is meant to include all intellectual abilities. The use of the term <u>cognition</u> in the more limited way seems more appropriate. After all, we do have the term <u>intellectual</u> to use for covering the whole range of abilities; there is no point in having two labels for the larger class of abilities (p. 62).

The categories of Guilford are of general interest to educators from the standpoint of their connection with the traditional concepts of problem solving and creativity. Guilford (1960) states that, using his factor-analytical point of view depicted in a three-dimensional model, one can "attempt to specify the pattern of abilities that contribute differentially to the solution of each type of problem" (p. 19). Problem solving, then, is potentially related to a large number of intellectual abilities.

Educational implications of the theory are apparent (Guilford, 1959).

The stimulus-response (S-R) model of teaching must now also include a consideration of the mediating organism and the characteristics of the organism. This is compatible with the S-O-R model adapted by educational psychologists. Educators are forced to think beyond the act of giving information and of forming associations to realize that teaching also helps the learner discover information.

Taxonomy of Bloom

One more approach to thought processes, an approach which is specific to education, is provided by a committee of college and university specialists in evaluation with Benjamin Bloom serving as chairman and editor. The published taxonomy (Bloom, c1956) is available for educators as a technique by which educational goals or objectives can be classified. Existing curricular goals can be compared to possible goals suggested by the taxonomic levels of cognitive behavior and with this as a guide for specifying objectives, it is easier to plan learning experiences and prepare evaluation devices.

The taxonomy of the cognitive domain can be described simply as a means of classifying thinking or cognitive processes, those processes (Bloom, c1956) "... which deal with the recall or recognition of knowledge and the development of intellectual skills and abilities" (p. 7). It is emphasized that the taxonomy is "... classifying ... the intended behavior of students -- the ways in which individuals are to act, think, or feel as the result of participating in some unit of instruction" (p. 12). However, this framework may also be applied in research as a means of analyzing actual behaviors of teachers and students.

The taxonomy contains six major classes representing a hierarchical order: knowledge, comprehension, application, analysis, synthesis and evaluation. Following are definitions of each of these classes taken from the Appendix (Bloom, c1956):

> 1.00 KNOWLEDGE ... the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting. ... the recall situation involves little more than bringing to mind the appropriate material (p. 201).
>
> 2.00 COMPREHENSION ... the lowest level of understanding. It refers to a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications (p. 204).
>
> 3.00 APPLICATION The use of abstractions in particular and concrete situations. The abstractions may be in the form of general ideas, rules of procedures, or generalized methods. The abstractions may also be technical principles, ideas, and theories which must be remembered and applied (p. 205).
>
> 4.00 ANALYSIS The breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit (p. 205).
>
> 5.00 SYNTHESIS The putting together of elements and parts so as to form a whole. This involves the process of working with pieces, parts, elements, etc., and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before (p. 206).
>
> 6.00 EVALUATION Judgments about the value of material and methods for given purposes. Quantitative and qualitative judgments about the extent to which material and methods satisfy criteria. Use of a standard of appraisal. The criteria may be those determined by the student or those which are given to him (p. 207).

Theory of Faculty of William M. Stewart School

A newer and lesser known approach to thought processes taken by the Faculty of the William M. Stewart School (ca. 1965) at the University of Utah is designed to be helpful in guiding teachers in the use of assignments

and questions in the classroom. The faculty were "... seeking ways to identify teaching behavior which could facilitate pupils' use of a wider variety of their mental powers" (p. 3). They were interested in this as an area of study because many investigators and writers in the field were saying that teachers often do not require students to go beyond simple recognition and recall in the classroom. Activities such as comparing, contrasting and generalizing are seldom required. These kinds of activities are called higher mental processes in the Utah materials.

A comment which may ease the minds of those persons who expect research efforts to produce clearly distinguished and defined results is made. (Faculty of William M. Stewart School, ca. 1965):

> ... there is some overlapping of meaning from one term to another and even from one level to another. Yet lacking is a fully satisfying degree of internal consistency among the terms and levels on the one hand, and mutual exclusion on the other. However, this fault is not peculiar to our schema, for the field is badly scrambled; definitive work is only now emerging (p. 3).

The hierarchical schema of mental processes includes four levels, each level described by two, three or four major words and these major words further defined by other words (Faculty of William M. Stewart School, ca. 1965):

Level 1: The lowest point in the hierarchy, it is described by the words retrieving (reflecting, remembering, recalling), identifying, discriminating and perceiving (sensing).

Level 2: This level includes inferring (imagining, exploring, organizing, and analyzing) and comparing and contrasting.

Level 3: The mental processes of defining (discovering, hypothesizing, abstracting, and integrating), judging, and evaluating are found

at the third level.

Level 4: This level is described by the terms creating (inventing, synthesizing) and generalizing.

Sentence definitions are given for each of these major and defining terms in the last four pages of the publication.

Research in Cognitive Processes

Theory and research have a reciprocal relationship. Research needs to have a theoretical basis if it is to have conceptual validity or provide a basis for evaluating behavior; theories need to be tested by means of research designs.

Educational research in cognitive processes develops in two stages. It is first necessary to adapt the theory to practical use; therefore, the initial stage of research is concerned with developing a cognitive system for describing in some unique way the various cognitive processes. Most research of this kind has resulted in observational and recording devices for describing cognitive processes occurring in the classroom setting. Educational research needs (Gallagher, 1968):

> ... some model or system by which to organize the myriad of behaviors in the classroom so that something of instructional value and theoretical significance can be deduced (p. 3).

In the second stage of research the descriptive system is applied in a variety of research designs to analyze the cognitive processes or to test hypotheses.

In the preceding section of this chapter various theories of cognition were presented. Three of these, the theories of Guilford, Bloom, and the Faculty of William M. Stewart School at the University of Utah, were

identified as providing the theoretical basis for this research. In this section, observational and recording devices based on the theoretical constructs of Guilford and Bloom are presented. No research developing from the schema proposed by the Faculty of William M. Stewart School was found. Also in this section, applications of the observational devices in various studies are reviewed.

Research based on Guilford theory

The Aschner-Gallagher system (Aschner, 1963; Gallagher and Aschner, 1963; Gallagher, 1968; Simon and Boyer, 1968) for classifying thought processes in the context of classroom verbal interaction was inspired by Guilford's conception of the structure of intellect. This classification system illustrates the development of an operational technique for measuring conceptual definitions (Gallagher and Aschner, 1963):

> The eventual goal of the project is to arrive at a description of the intellectual processes that occur in the classroom and, through this, to acquire not only a greater understanding of the teaching process itself, but also to work out more effective ways of training teachers for the stimulation of productive thought processes (p. 193).

Aschner and Gallagher found it difficult to distinguish memory from cognition when actually classifying thought processes and therefore combined these two into one category for analysis. They also added a category called routine to take care of periods when no real thinking processes were occurring. In using the technique for studying classroom cognitive processes a tally was made every time the behavior changed. The descriptions of the categories as they appear in an antholcgy of observation systems (Simon and Boyer, 1968) are:

I. ROUTINE (R)

This category includes routine classroom procedural matters such as management of the classroom, the structuring of class discussion and approval or disapproval of the idea or the person (Section 2-3, p. 5).

II. COGNITIVE-MEMORY (C-M)

C-M operations represent the simple reproduction of facts, formulas and other items of remembered content through use of such processes as recognition, rote memory and selective recall (Section 2-3, p. 6).

III. CONVERGENT THINKING

Convergent thinking is thought operation involving the analysis and integration of given or remembered data. It leads to one expected result because of the tightly structured framework which limits it (Section 2-3, p. 7).

IV. EVALUATIVE THINKING (ET)

Evaluative thinking deals with matters of value rather than matters of fact and is characterized by verbal performance by its judgmental character (Section 2-3, p. 8).

V. DIVERGENT THINKING (DT)

In a Divergent Thinking sequence, individuals are free to independently generate their own data within a data-poor situation, often taking a new direction or perspective (Section 2-3, p. 8).

This category system has been used in research focused on classroom interaction. Gallagher and Aschner (1963) studied verbal interaction in social-studies classes for gifted children. Five audiotapes were made in each of twelve classes. Student responses in the thinking activities were tallied as follows (p. 191): cognitive-memory, 52 percent; convergent thinking, 20 percent; divergent thinking, 6 percent; evaluative thinking, 22 percent. Teachers were higher in the cognitive-memory and evaluative thinking categories and lower in the use of convergent and divergent thinking categories than were the students. A slight increase in the number of questions by the teacher elicited a larger increase in responses from the students, each question bringing responses from many gifted children.

Trowbridge (1969) used the Aschner-Gallagher system in an evaluation

of creativity in the classroom. Creativity was measured by the divergent thinking category of the system. Teachers who had participated in a special program of workshops on the promotion of creativity in pupils were studied over time and were also studied in relation to teachers who had not participated in the workshops. In the longitudinal study of the trained teachers, a marked decrease was found in the percentage of time spent talking and also in the percentage of time spent in routine, nonthinking activities as the year progressed. The percentage of divergent and evaluative thinking increased, accompanied by a decrease in memory and cognition. In one comparison with untrained teachers, the trained teachers talked 10 percent less and used 14 percent less routine.

Hunter (1969) studied the effect that training in the use of a new science curriculum had upon the verbal behavior of first grade teachers as they taught science. This research illustrates the use of observational and analysis systems to measure the results of certain training effects upon behaviors. The emphasis here is on the behaviors of the teachers. To analyze the verbal behaviors of trained and untrained teachers, Hunter used her revision of the Verbal Interaction Category System (Amidon and Hunter, 1967). Four kinds of questions were defined under teacher talk, the definitions following the categories of the Aschner-Gallagher system: cognitive-memory, convergent thinking, and evaluative thinking. Hunter (1969) found that:

> A comparison of the categories of verbal behavior between the two groups of teachers indicated similarity in all categories -- that is, the trained teachers did not vary from the untrained in their classroom verbal behavior (p. 9).

The findings of the comparison made by Hunter are not particularly

important to this review except as they illustrate a point. First, the teachers were trained to use a new curriculum and this training stressed allowing pupils to talk and to use materials. The analytical instrument did determine that the trained teachers talked significantly less than the untrained teachers. However, the talk patterns, and especially the questioning patterns, were not any different after the training than before the training for the probable reason that the training was not focused on these behaviors. Training in verbal skills is known to change verbal behavior, but in order to determine this change an analytical instrument must measure the effect of the particular training. For example, the analysis in the study by Hunter should probably have focused only on behavioral changes in the area of allowing pupils to use materials and to talk.

Research based on Bloom taxonomy

The taxonomy of cognitive behaviors (Bloom, c1956) has been adapted to a variety of research designs. Observational and recording devices have been developed by applying the original taxonomic levels with very little change. Many different researchers have done this; therefore, no one person can be given credit for developing a system based on the theory of Bloom.

Pfeiffer and Davis (1965) applied the categories of Bloom to an analysis of the levels of thinking demanded in teacher-made semester examinations at the ninth-grade level. The examinations were classified according to subject matter area and three types of programs; college preparatory, business, and prevocational. They found that "... there was great similarity in the cognitive objectives within each of the three programs of study ..." (p. 7). All questions on the examinations in home economics were in the

knowledge category, 70 percent asking for knowledge of specifics and the other 30 percent asking for knowledge of ways and means of dealing with specifics. In referring to home economics they commented, "The proportion of test items ... calling for knowledge of specific facts seems unusually high, particularly in light of the fact that these courses purport to be 'practical'" (p. 5). They also made the following comments concerning general classroom interaction:

> The overall lack of concern for the objectives in the areas of analysis, synthesis, and evaluation, while not unusual, is surely depressing. In a sense, these junior high school students were intellectually deprived, not having the opportunity, at least on examinations, to deal with much of the basic nature of the course. Thus, these students, academically able and potential dropouts, were treated to a steady diet of bits-upon-pieces, specific-upon-specific. Only in English and, for a limited group in world history, did students have the intellectual challenge of the higher cognitive processes. Surely, all these courses could have given attention to analysis, synthesis, and evaluation, perhaps in varying degrees, but at least some attention. Only as all courses focus attention on all the intellectual skills and processes will schooling begin to achieve the general goal of fostering thinking (p. 9).

Questions appearing in randomly selected chapters of three recently published fifth-grade social-studies texts were analyzed using the categories of Bloom (Davis and Hunkins, 1966). In analyzing the questions seven experienced teachers agreed upon the following classification (p. 287): knowledge, 87 percent; comprehension, 9 percent; application, 4 percent; analysis, 0 percent; synthesis, 1 percent; evaluation, 1 percent.

The objective of a later study by Hunkins (1968) was to determine whether a dominant number of analysis and evaluation questions in social studies test-type materials would improve achievement as analyzed by the taxonomic levels of Bloom. Sixth-grade pupils in 11 classes were randomly assigned to condition A, with 50 percent of the text questions being

analytical and evaluative, or to condition B, with 90 percent of the questions being at the lower knowledge level. Teachers were not involved in the learning situation. Significantly better achievement in the areas of application and evaluation occurred on post-tests for those students experiencing condition A.

Davis and Tinsley (1967) developed an inventory based on the theory of Bloom and analyzed cognitive objectives revealed in questions asked by 44 social-studies student teachers in classrooms. Because 53 percent of these questions were at the memory level they suggested that more attention is needed in the other cognitive areas of classroom learning and that attention to questioning techniques needs to be given in pre-service and in-service teacher education.

Following these suggestions, Farley and Clegg (1969) designed a study to determine if student teachers could be trained to change their questioning behavior. Student teachers in the experimental group received eight lessons on the taxonomy of Bloom; the control group received a placebo treatment. Two groups of observers then rated audiotapes made during the third, fifth, and seventh weeks of the student teaching experience. Analysis of the observers' ratings revealed a significant difference favoring the experimental group which operated more frequently at the higher cognitive levels. The control group was rated as having 82 percent of their questions at the lower two levels while the experimental group had 58 percent of their questions rated at these levels.

A different application of Bloom's categories was reported by Doak (1970). The categories were used in classifying the levels of talk of both teachers and pupils in Track I, lower ability classes, and Track IV,

highest ability classes. The purposes were to identify the levels of verbal behaviors in the two ability groups and to determine if there were significant differences between the two ability groups in the use of the various cognitive levels.

> None of the statistical comparisons [between Track I and Track IV] yielded significant differences between means at the .05 level. Generalizations derived from the data indicated that more verbal interchanges were plotted within the knowledge interval than in any other; the second most frequently plotted interval was the comprehension category; when points were plotted above the comprehension interval, they tended to occur during the middle part of the lesson (at approximately the eighth verbal interchange); in most instances, there was high incidence of congruence between teacher and pupil levels of thinking, and, since the teacher in most cases initiated verbal interaction, it appeared that the students were fulfilling the teacher's objectives successfully; and, when the level of thinking was elevated abruptly, there was a tendency for divergence of level of thinking between pupil and teacher to occur. The level of thinking exhibited by the verbal behavior following the attempted abrupt elevation tended to fall below the level recorded in the episode immediately prior to the attempted abrupt elevation.
>
> . . . . . .
>
> If problem identification and felt needs, in fact, do precede behavioral change in teachers, then this evaluative approach may be viewed as one possible way of identifying curricular problems and encouraging teachers to go beyond the rote process of teaching for factual understanding only (p. 179).

Brown et al. (1967) developed the Florida Taxonomy of Cognitive Behavior which provides another framework for observing and recording the cognitive behaviors of the teacher and the students in classrooms. The nine major categories are very similar to those of Bloom: 1) knowledge of specifics, 2) knowledge of ways and means of dealing with specifics, 3) knowledge of universals and abstractions, 4) translation, 5) interpretation, 6) application, 7) analysis, 8) synthesis, and 9) evaluation. The Florida instrument is unique, however, because these nine categories are further

sub-divided into 55 different behaviors. For example, the major category of application contains four sub-categories: 1) application of previous learning to a new situation, 2) application of a principle to a new situation, 3) application of abstract knowledge in a practical situation and 4) identification, selection and carrying out of a process. This instrument has been used in classroom observation for pre-service and in-service education of teachers. Results of research could not be found in the literature nor have they been cited by Brown (1969).

A book has been written for those persons who design and ask questions in the classroom (Sanders, c1966). Once again the theory of Bloom has provided the basic ideas underlying the study of questions, which is the topic of this book. The first category, knowledge, has been called memory by Sanders. Whereas Bloom placed translation, interpretation and extrapolation under the second category of comprehension, Sanders has treated translation and interpretation as separate categories and has not included extrapolation. With these exceptions the categories developed by Sanders for the design, use and study of classroom questions remains the same as the categories of Bloom.

To summarize, one common application of the categories of cognitive processes as developed by Bloom has been to identify the levels of questions: 1) asked by teachers in the classroom, 2) appearing in textbooks, and 3) written on teacher-made examinations. The theory of Bloom has also been applied in testing the hypothesis that students exposed to test materials requiring higher levels of cognitive behaviors will subsequently exhibit higher cognitive behaviors on tests. Third, the categories developed by Bloom have been applied in pre-service and in-service education of

teachers for purposes of self-evaluation and for inducing a behavioral change. A fourth application of the cognitive theory has been to determine if the ability level of students has any effect upon the level of cognitive performance exhibited in the classroom.

QUALITIES DESIRED IN OBSERVATIONAL INSTRUMENTS

Much has been written about the need for worthwhile instruments to describe and evaluate behaviors that occur in the educational setting of the classroom. For example, Brown (1969) says:

> It simply is not possible to evaluate teacher competence fairly and meaningfully without first obtaining accurate and reliable descriptions of the teacher's classroom performance (p. 3).

Observational systems are needed if there is to be a basis for changing the classroom behavior of teachers (Kaplan, 1969). Borg (c1963) further discusses the need for well-defined instruments for observational studies.

> Most of what we know about the persons around us is the result of the casual observations that we carry on almost constantly in our daily activities. The observations that are conducted in order to obtain scientific information, however, are far different from these casual observations. The principal differences are that scientific observation attempts to gather objective data and to reduce or eliminate the biases that distort most of our casual observations. The observational technique provides us with what is often the only logical approach available for the study of complex behavior. Much of the behavior that interests us in education, such as the role of the principal in the school situation, teacher-pupil interaction within the classroom, and teacher effectiveness is of a highly complex nature. The observational approach, which permits the direct study of complex behavior, seems an obvious choice for research in these areas (p. 237).

Kaplan (1969) provides the following definition and rationale for research involving observation of classroom behaviors:

> An observational system is a way of identifying, ordering, and classifying behaviors for the purpose of examination, study, and evaluation. It permits an observer to look at specific behaviors of teaching and learning and react to them accordingly or as the objectives stated for the lesson or classroom would suggest (p. 16).

If education and educational research are to move forward the task of developing measuring instruments must be undertaken with the goal being to make these instruments as refined as possible. Qualities desired in any

measurement procedure are objectivity, the various types of validity, and reliability. Each of these three qualities will be discussed from the perspective of their application to research concerning the development of observational instruments.

Objectivity

Instruments that are designed for describing and evaluating classroom behaviors need to be objective. Borg (c1963) defines the term:

> Objectivity, as it refers to measurement devices in education, is determined largely by the degree to which the measure is uninfluenced or undistorted by the beliefs or prejudices of the individual using the instrument (p. 78).

Objectivity is a characteristic that is of concern in the development and use of devices for studying classroom interaction. Brown and Webb (1968) state that often those who develop and use observational instruments make the error of assuming observers can be trained to be objective and to make judgments that are value free.

> A team of observers can be trained to the point of near-perfect agreement, but this does not eliminate the possibility that instead of making numerous subjective judgments of a differing and conflicting nature (as they did prior to training), they now make only one -- the same one (p. 35).

Brown and Webb are concerned that bias and observational error can influence the objectivity of the measurements to a considerable degree because of the personal judgments often required by those using the measuring instruments. Bias, if influencing an observer's judgment, is a problem because it is constant and in one direction. However, Mehrens and Lehmann (c1969) say that "... if the errors are assumed to be random, the positive and negative errors will cancel each other, and the mean error will be zero" (p. 33). Therefore, the influence of bias upon objectivity is of more concern than

the influence of errors made by the observers in categorizing behaviors.

The objectivity of instruments can be improved by making certain the categories or items of an instrument and the procedures for using the instrument are clearly defined. Objectivity can also be improved by eliminating those situations which, due to their nature, call for personal judgments. However, attempts to increase objectivity may weaken other characteristics of the measuring device. For example, in using an observational instrument to describe cognitive classroom interaction, the degree to which the instrument describes cognitive behaviors can be seriously weakened if all situations calling for personal judgments are eliminated. "Thus, in educational research, the level of objectivity required must be weighed against other important test characteristics such as validity" (Borg, c1963, p. 79). As previously emphasized in this review, the development of analytical systems for studying cognition should be based on a sound theoretical framework as a source of definitions of categories. If this is done, it is likely that objectivity can be enhanced without weakening other characteristics of the observational system.

Validity

Validity is a second characteristic or quality that concerns those researchers developing and using devices for studying classroom interaction. Mehrens and Lehmann (c1969) define validity as "... the degree to which a test is capable of achieving certain aims .... [or] as truthfulness -- does the test measure what it purports to measure" (p. 42). Thorndike and Hagen (c1969) also provide a discussion of the meaning of this characteristic.

> The first and foremost question to be asked with respect to any testing procedure is: How valid is it? When we ask this question, we are inquiring whether the test measures what we want it to measure, all of what we want it to measure, and nothing but what we want it to measure (p. 163).

Validity as a concept is practically meaningless until the specific type of validity to which one is referring is included in the concept. The latest edition of Standards for Educational and Psychological Tests and Manuals (French and Michael, c1966) distinguishes three common aims of measurement devices and states that one of three kinds of validity corresponds to each of these three aims. The terms most commonly used to designate these three types of validity (French and Michael, c1966, p. 12; Mehrens and Lehmann, c1969, p. 43; Thorndike and Hagen, c1969, p. 164) are: 1) content validity, 2) criterion-related validity, and 3) construct validity. Discussion of the three types of validity and their relation to the aims of classroom observation is needed.

Content validity

French and Michael (c1966) define the first type:

> Content validity is demonstrated by showing how well the content of the test samples the class situations or subject matter about which conclusions are to be drawn. Content validity is especially important for achievement and proficiency measures and for measures of adjustment or social behavior based on observation in selected situations (p. 12).

The concept of content validity can be applied to observational instruments. For example, if an instrument is reputed to measure the levels of cognitive behaviors occurring in the classroom, there must be some basis for stating that the levels are measured. Here again, an instrument designed with reference to one or more theories will more likely be representative of the various levels of cognition and will be more valuable as a

basis for conclusions. As theories develop and are used as bases for measurement instruments, content validity of these instruments should improve. Training of observers may also have a positive effect on content validity (Webb and Brown, 1968).

Criterion-related validity

A definition of the second type of validity is provided by Mehrens and Lehmann (c1969):

> Criterion-related validity pertains to the technique of studying the relationship between the test scores and independent external measures. Some writers make a distinction between two kinds of criterion-related validity: concurrent validity and predictive validity. The only distinction between these pertains to the time the criterion data are gathered. When they are collected at approximately the same time as the test data, we speak of concurrent validity. When they are gathered at a later date, we have a measure of predictive validity .... Whether criterion-related validity should be expressed as concurrent or predictive depends on whether we are primarily interested in prediction or in assessment of current status (p. 43).

The definition given by French and Michael (c1966) further clarifies the concept of this type of validity:

> Criterion-related validity is demonstrated by comparing the test scores with one or more external variables considered to provide a direct measure of the characteristic or behavior in question (p. 13).

The criterion-related validity of an observational system must be determined if the usefulness of the system is to be established. For example, an observational instrument may be used to describe the level and occurrence of cognitive behaviors promoted by teachers in the classroom. From this description of behaviors conclusions concerning the levels of cognition of which students are capable can be drawn. At approximately the same time or at a later time an achievement test containing items calling for all the

various levels of cognition to be exhibited by students can be given. If there is a high relationship between the level and occurrence of cognitive behaviors promoted by the teacher and the performance by the students on the achievement tests, criterion-related validity may be said to be determined for the observation. At present criterion-related validity is not determined for most observational instruments as a part of the initial procedure of instrument development. However, if an instrument is to be valuable for more than describing behaviors, criterion-related validity must be determined. When the behaviors as described by a particular observational system do not have any relationship to related behaviors and achievements of students the usefulness of the instrument is negligible and the system should be abandoned.

Construct validity

Construct validity is the third type of validity and refers to how closely an instrument reflects or is related to a specified theoretical framework. French and Michael (c1966) state:

> Construct validity is evaluated by investigating what qualities a test measures, that is, by determining the degree to which certain explanatory concepts or constructs account for performance on the test .... Essentially, studies of construct validity check on the theory underlying the test (p. 13).

This type of validity is most often established for an instrument by correlating the quantified data from the instrument with measurements made by an instrument or a test already said to have construct validity. Another approach is to form certain hypotheses based on the theory underlying the instrument. For example, from the theory of Guilford (1956) concerning the structure of intellect one could hypothesize that people perform

various cognitive operations as defined by Guilford and that these cognitive operations could be categorized on the basis of verbal behaviors. An observational system similar to the one developed in this study could be designed based on Guilford's theory and then tested by categorizing verbal behaviors. In view of the data collected using the observational instrument an inference could be made concerning the adequacy of the theory for explaining the data collected.

A minimum first step then, in instrument development is the identification of a theoretical framework which forms the basis for the instrument. This is necessary to increase the understanding of the psychological or educational qualities which the observational instrument measures.

Reliability

Reliability is a third characteristic or quality that is of concern to those developing and using observational systems for studying classroom behaviors. Mehrens and Lehmann (c1969) define this characteristic as follows:

> Reliability can be defined as the degree of consistency between two measures of the same thing. This is neither a theoretical nor an operational definition but is more of a conceptual (or layman's) definition (p. 32).

French and Michael (c1966) state that:

> Reliability refers to the accuracy (consistency and stability) of measurement by a test. Any direct measurement of such consistency obviously calls for a comparison between at least two measurements (p. 25).

A definition of reliability in educational terms is also given by Borg (c1963):

> Reliability, as applied to educational measurements, may be defined as the level of consistency of the measuring device. In general, this consistency reflects the degree to which the test may be considered stable or may be depended upon to yield

similar test results under similar circumstances (p. 84).

Reliability is an important characteristic of observational instruments which describe and analyze classroom interaction. Reliability of instruments which involve decisions made by observers is commonly established on the basis of agreement among observers. Agreement by one observer using the instrument in analyzing the same behaviors at two different times also is a means of establishing reliability. Flanders (1967), Brown et al. (1968), and Abramson (1969) have described techniques for calculating reliability of observers. One-way analysis of variance and chi-square are the statistical techniques used for most estimates of observer reliability.

Because of the belief stated earlier that training of observers may only result in one subjective judgment instead of many, Brown and Webb (1968) have developed a mathematical definition which estimates the reliability of one person observing the same classroom situation at two different times, intra-observer reliability. Webb (1968) found that untrained observers often reached closer agreement on the behavior they observed than did trained observers, negating the belief that group training is necessary to improve reliability. Therefore, there seems to be some evidence for consideration of the intra-observer reliability concept as being useful for obtaining reliable observations of classroom behaviors. It is now possible by the use of audiotapes and videotapes for one observer to view the same classroom at two different times.

Two other problems which may alter the reliability of observational measurements of classroom behaviors are: 1) the effects of an observer upon the classroom interaction and 2) the length and the number of observations of any one classroom situation that are needed to adequately sample

behavior. Many teachers do not behave in their usual manner when observers or monitoring equipment are present; therefore, the behaviors observed and recorded may not be a reliable measure of normal classroom behaviors. They are only reliable to the extent that they measure behavior of a teacher when something, a person or a piece of equipment, has been introduced into the situation.

Samph (1969) electronically monitored classrooms in which observers were present and in which observers were absent and analyzed the teacher's verbal behaviors using Flander's Interaction Analysis System, an instrument which gives a measure of indirect versus direct teaching behaviors. An observer's presence in the classroom was related to more indirect behaviors being exhibited by the teacher. Therefore, evidence was provided for the hypothesis that an observer's presence does influence the behavior of those being observed.

Techniques for reducing the effect of the observer are available. One approach is to have the observer present in the classroom long enough to become part of the setting before any description or analysis of behavior is attempted. However, this approach is often not practical. A second method (Williams, 1967) for reducing the effects of the presence of the observer is to use a remotely controlled videotape recorder. In this situation only a camera is visible in the classroom. This camera is controlled from a van parked outside the school.

There are instances where it may be impossible to reduce or eliminate the effect an observer or a piece of equipment has upon a situation. In these cases no observational instrument can be designed to give an undistorted picture of classroom behaviors; it can at best give a reliable

report of the distorted behaviors.

It is often impractical in research involving classroom interaction to observe any one classroom for a very long time. Assurance is needed that the descriptions of the classroom which result when the observational instrument is applied for the time available provide a reliable and representative picture of what occurs in that one classroom, other factors such as the presence of an observer or equipment being considered. This problem can be handled in two ways; by having well-developed instruments, and by making an optimum number of observations, each for an optimum length of time. This optimum number and length may vary with the teacher involved, the subject matter, the observational instrument, the observational technique, and the precision needed to meet the objectives of the research. To generalize beyond one classroom concerning typical classroom behavior one must have, in addition to a well-developed instrument and optimum time sample, a random sample of the population of classrooms about which the generalizations are to be made.

PROCEDURE FOR DEVELOPING AND TESTING INSTRUMENT

The major purpose of this study was to develop a method for observing and recording cognitive classroom interaction between teachers and their students and to test the method in situations similar to those for which it was designed. A secondary purpose was to suggest ways of applying the method in the pre-service and in-service education of teachers.

First Phase: Instrument for Teachers

The research began in September, 1968, as a project funded by the State of Iowa, Vocational Education Branch, Department of Public Instruction. The title of the project during the first year was An Observational Method for Selected Teaching Behaviors of Home Economics Teachers. Specific objectives of the research project were to:

A. Develop an observational instrument for use with home economics teachers in the analysis of teaching behaviors that stimulate student cognitive responses.

B. Determine the inter-observer reliability in reporting the observed components of the teaching behaviors.

C. Prepare research personnel for the analysis of teaching behaviors.

Dr. Alberta Hill, Head, Home Economics Education Department, Iowa State University, served as director of the research during the first year. Other members of the research team, also in the Home Economics Education Department at Iowa State University, included: Dr. Alyce M. Fanslow and Dr. Virginia F. Thomas, consultants; Mrs. Judy K. Brun, graduate assistant; Mrs. Karen W. Zimmerman, intern, Educational Research Fellowship.

Development of instrument

A thorough review of the literature was made to provide the research team with direction for developing observational categories which could be used to analyze home economics teaching behaviors that stimulate student cognitive responses. Theoretical structures of intellectual and cognitive processes presented in the literature were identified. Relationships among these different structures were studied and note made of common and unique elements.

Provisions were made for the research team to view videotapes and films made of teacher-pupil interaction in classrooms. The team attempted to apply various categories of behavior derived from the theoretical structures identified in the literature in analyzing the behaviors observed. This experience provided another basis for developing a system for observation.

Some categories of behaviors derived from the compilation of theories seemed more applicable than others to the behaviors actually occurring during the teacher-pupil classroom interactions viewed and were therefore extracted for further consideration. Other categories were developed to produce an instrument which seemed to include classifications for all teaching behaviors that stimulate student cognitive responses. Further development of the categories selected as being appropriate to the analysis of these teaching behaviors occurred as the research team, as a group, viewed classroom behaviors on videotapes and discussed their perceptions and problems in the first attempts to classify behaviors. The five categories first accepted for the instrument designed to analyze home economics classroom teaching behaviors that stimulate student cognitive responses were: 1) recall; 2) use or select and apply knowledge; 3) analyze, compare, contrast;

4) judge, evaluate, define significance; and 5) create.

The definitions for each of the five categories were further refined as the research team discussed meanings and attempted to make the statement of categories as clear and descriptive as possible. Refinements and corrections were also made as the instrument categories were used to analyze classroom behaviors on videotapes made of micro-teaching sessions taught by graduate students in home economics education. The instrument categories and definitions as they were at the end of the first year of the project appear in Appendix A.

Directions for observing and recording were developed to assist observers in making objective and consistent judgments about the category of behavior being observed. The directions, with a few additions and modifications, apply to the expanded instrument for analyzing the behaviors of both teachers and students; therefore, they are discussed in the next chapter as part of the presentation of the instrument. A sample of the tally sheet on which the behaviors of the teacher were recorded is found in Appendix B.

Study of inter-observer reliability

The next step involved an investigation of the ability of the members of the research team to reach agreement in reporting observed components of teaching behaviors as described by the observational instrument. Videotapes were made of five micro-teaching sessions taught by home economics education graduate students at Iowa State University to students from Ames High School who volunteered to participate. The behaviors exhibited on these videotapes were categorized by four members of the research team and a contingency chi-square analysis to test for differences among observers was

made using the frequency totals in each category of behavior for all five micro-lessons added together (Wert et al., c1954, p. 155).

A chi-square value of 21.03 at the 5 percent level of significance and 26.22 at the 1 percent level would be required to reject the hypothesis of no difference among the four observers. The analysis gave a chi-square value of 43.62, showing that there was a significant difference among observers and they were not agreeing on categorizing the behaviors they were observing.

Further discussion of definitions and examples of categories was undertaken by the research team. Videotapes of the micro-lessons were reviewed to discover where discrepancies occurred and these discrepancies were discussed until agreement was reached.

Next, videotapes were made of five public school home economics classes in Iowa and one college home economics class at Iowa State University. The behaviors appearing on these tapes were categorized by three members of the research team. The first chi-square analysis to test for differences among observers was made using the frequency totals in each category of behavior for all six home economics classes added together.

A chi-square value of 15.51 at the 5 percent level of significance and 20.09 at the 1 percent level would be required to reject the hypothesis of no difference among the three observers. The analysis gave a chi-square value of 27.69, again showing a significant difference among observers and unsatisfactory inter-observer reliability. However, the chi-square value of 27.69 was not as significant as the previous chi-square value of 43.62.

To determine which of the five categories of behavior were contributing

in greatest measure to the disagreement among observers, further chi-square analyses were made (Wert et al., c1954, p. 146). A chi-square analysis was made to determine differences among observers in each of the five categories for each home economics class. The 30 chi-square values given in Table 1 indicate that the major disagreements occurred for home economics classes A, B, C, and F in category three, analyze-compare-contrast, and category four, judge-evaluate-define significance.

Table 1. Chi-square values for each of six home economics classes in each of five categories

Category	Chi-square values for Home Economics classes					
	A	B	C	D	E	F
1	13.79	10.20	10.53	.22	.19	1.16
2	2.82	4.74	.39	.47	4.08	6.00*
3	8.22*	10.20**	10.53**	1.76	7.97*	1.14
4	13.79**	.82	6.45*	1.08	1.08	14.01**
5	3.88	.00	12.00**	.00	.00	3.17

*Table value $_{.05}$ = 5.99 (2 d.f.).

**Table value $_{.01}$ = 9.21 (2 d.f.).

Chi-square analyses were also made in each of the five categories for all home economics classes added together. The five chi-square values given in Table 2 indicate that the major disagreement for all classes seemed to be in category five, create.

Further refinement of category definitions was not attempted at that

Table 2. Chi-square values for the total of all six home economics classes in each of five categories

Category	Chi-square values
1	3.57
2	1.73
3	.64
4	5.91
5	15.91**

**Table value $_{.01}$ = 9.21 (2 d.f.).

time. It was suggested that discussion and refinement of definitions of categories in which greatest discrepancies occurred would be helpful in increasing inter-observer reliability.

Another factor which seemed to be contributing to discrepancies was apparent when the total number of behaviors tallied by each observer was compared. The observers were not agreeing on the total number of behaviors observed for each home economics class as was shown when the tallies were placed on analysis sheets like those illustrated in Appendixes C and D.

A recommendation was made that more practice in identifying cognitive behaviors be obtained by the observers in an attempt to increase the observers' ability to distinguish and detect teaching behaviors that stimulate cognitive processes in students. To increase observer agreement on the total number of behaviors observed, it was recommended that more directions be given the observers concerning where to begin and end the observation of

each video tape. One suggestion was to provide cues in terms of the classroom dialogue rather than to use the counter mechanism on the videotape recorder. The likelihood of all observers categorizing exactly the same behaviors would then be increased.

The first phase of the research project was completed in August 1969. At this time a report of the research was made to the funding agency (Hill et al., 1969).

Second Phase: Expanded Instrument

Findings and recommendations from the first phase of the research project were studied as a basis for planning objectives of the second phase of the project. This phase of the project was conducted as a dissertation project by the graduate assistant who was instrumental in developing the initial categories for teaching behaviors and in studying reliability among observers.

The objectives specific to the second phase of the study were to:

A. Extend the method for analyzing teaching behaviors developed in the first phase of the research so it could also be used in the analysis of responses of students to these teaching behaviors.

B. Study and refine, as needed, the method for observing and recording behaviors of teachers and their students.

C. Test the observational method for analyzing teacher-pupil cognitive interaction in the classroom in three ways.

1. Study inter-observer and intra-observer reliability.
2. Categorize cognitive behaviors in home economics classrooms as displayed on videotapes.

3. Study the data supplied by the categorization of behaviors to determine:
   a) levels and total number of behaviors exhibited;
   b) relationships between behaviors of teachers and students;
   c) ability of the method to discriminate among the 20 classrooms.

D. Suggest applications of the observational method for home economics pre-service and in-service education of teachers.

Addition of student categories

The first step in the second phase of the study was to expand the observational method to include categories for analyzing the responses made by students to the cognitive stimulations of the teacher. These categories for students were worded very much like the correspondong categories for teachers. The category system, consisting of five categories for teachers and five categories for students, was applied in an analysis of cognitive behaviors that were recorded on the videotapes used in the first phase of the research. As a result of this trial a decision was made to add a sixth category for students, category zero, which would be used for those occasions when a teacher attempted to stimulate cognitive behaviors and students did not respond in a cognitive manner. The six student categories in their initial form are given in Appendix E.

First study of inter-observer reliability

At this stage of instrument development the first attempts were made to establish reliability among observers on the use of the method to record classroom cognitive behaviors for both teachers and students. Five other

persons were trained by the investigator in the use of the category system. All the first applications of the method were made in observing classroom behaviors as they appeared on videotapes made in micro-teaching sessions taught by a graduate student to three high school students. All classes were in home economics subject matter.

Training of observers consisted of three group meetings at which the category system and the procedure for recording behaviors were thoroughly discussed. In the intervals between group meetings the group members, including the investigator, individually practiced applying the observational technique in an analysis of classroom cognitive behaviors as they appeared on an assigned videotape. Questions were raised at the group meetings concerning the categorizing of those behaviors on which members did not agree.

The contingency chi-square technique used in the first phase of the research was again applied to all reliability calculations. The analysis was made on the total number of tallies made by each observer in each category, zero through five, regardless of whether they were teacher or student behaviors. The number of observers available to categorize any one tape varied but the investigator was always one of the observers categorizing each of the videotapes used in establishing reliability. Observers did not always tally behaviors in all categories for any one videotape observed and did not always tally an average of five times for all categories; therefore, certain categories were eliminated from the chi-square analysis as an expected value of approximately five could not be assumed. Because the number of observers varied and because the number of categories with sufficient tallies for chi-square analysis varied, the degrees of freedom for the analyses were seldom the same.

When the investigator thought the members were sufficiently trained a videotape made in a micro-teaching session was selected for analysis as a basis for calculation of inter-observer reliability. The behaviors exhibited on the first videotape were thought to be at a very low and consistent cognitive level. The tape was approximately five minutes long. The simplicity of the behaviors on this first videotape was a possible explanation for the encouraging results of the first calculation of reliability among those who observed and recorded these behaviors (Table 3, Trial 1a). At the next group meeting those few disagreements that existed among observers on the analysis of the behaviors were discussed, the behaviors exhibited on the same videotape were re-categorized, and the amount of agreement among

Table 3. Summary of results of chi-square analyses indicating level of agreement among observers

Trial	Chi-square Value	d.f.	Chi-square Table Values .05	Chi-square Table Values .01	Observers
1a	8.25	4	9.49	13.28	5
1b	3.99	5	11.07	15.09	6
2	105.92**	12	21.03	26.22	5
3a	42.83**	6	12.59	16.81	3
3b	6.26	6	12.59	16.81	3
4a	7.83	4	9.49	13.28	3
4b	8.96	6	12.59	16.81	3
5a	42.52**	10	18.31	23.21	3
5b	5.15	4	9.49	13.28	2
5c	11.29	8	15.51	20.09	3

**Significant at the .01 level.

observers was found to be even more satisfactory (Table 3, Trial 1b). In analyzing the behaviors on the first videotape only category one, recall, and category two, use or select and apply knowledge, were used with enough frequency to be included in the analysis. This fact accounts for the few degrees of freedom.

The second videotape assigned to the group was of a micro-teaching session approximately 15 minutes long and contained a wide range of behaviors. The amount of agreement among the observers who analyzed the behaviors exhibited on this tape was low (Table 3, Trial 2).

At this stage of the work toward establishing reliability among observers two of the members were dropped from the group. They were in need of extended training before further participation in this study and three observers seemed adequate.

The three remaining members next analyzed the behaviors exhibited on a videotape of a micro-teaching session approximately 20 minutes in length. Agreement among the observers was still not satisfactory (Table 3, Trial 3a).

Revision of instrument

Certain inconsistencies among observers seemed to occur because of the nature of the definitions of the categories for cognitive behaviors, the examples given to illustrate these behaviors, and the procedures for recording behaviors. A major revision was made of the instrument categories and of the procedures for tallying the observed behaviors. New examples, showing behaviors of both teacher and students, were taken from the library of behaviors collected on videotapes. The revised observational method appears in complete form in the next chapter.

Second study of inter-observer reliability

The ability of observers to agree on the tallying of classroom cognitive behaviors using the revised instrument was studied. The behaviors on the last videotape viewed before revision were tallied again by the observers. This time satisfactory agreement was exhibited (Table 3, Trial 3b).

The behaviors exhibited on a typescript of a full-length home economics classroom were next analyzed by the observers to see if the variables of length and source of behaviors would have an obvious influence upon reliability among observers. On the first analysis an acceptable level of agreement was reached (Table 3, Trial 4a). After a discussion among the observers a second analysis of the same typescript was made and a level of agreement was reached that was just slightly better than that resulting from the first analysis (Table 3, Trial 4b). As a result of the discussion among the observers, behaviors were tallied in a wider range of categories on the second analysis. This led to the increase in the degrees of freedom in Trial 4b.

Although three consecutive analyses had resulted in chi-square values indicating no significant differences among observers, one more type of tallying situation was analyzed by the observers. The instrument was ultimately to be tested by the investigator for analyzing the behaviors occuring in many full-length class sessions as they appeared on videotape. Therefore, it seemed necessary that reliability of observers be studied in a situation with these same characteristics.

A full-length videotape of a high school home economics classroom was selected from the videotape library and the behaviors were analyzed by the

observers. The chi-square test of the tallies made by the observers indicated that they were not agreeing on the behaviors they observed (Table 3, Trial 5a). An inspection of the data indicated that one of the three observers was deviating widely from the other two. Because of this a chi-square test was made of the tallying of the other two observers; this test showed a high level of agreement (Table 3, Trial 5b). Study and discussion of the third observer's tallies revealed a misunderstanding of the definition of a category which resulted in an incorrect tallying procedure. The third observer, after further training, re-analyzed the behaviors on the videotape. This re-analysis was used with the original analyses of the other two observers to calculate another chi-square value. Agreement among observers was indicated (Table 3, Trial 5c); therefore, the study of inter-observer reliability was terminated. The investigator was ready to test the instrument by analyzing cognitive behaviors occurring in home economics classrooms and studying intra-observer reliability.

Study of intra-observer reliability

Reliability of the investigator when observing and recording the same classroom situation at two different times was studied. The investigator used the observational method to record classroom cognitive behaviors appearing on three different videotapes. The time between a first and a second viewing of the same videotape ranged from one to four weeks.

The behaviors reported for the two different observations of each tape were quite consistent and yielded low chi-square values (Table 4). Therefore, intra-observer reliability was indicated for the investigator when applying the observational instrument in recording cognitive behaviors.

Table 4. Summary of results of chi-square analyses indicating level of agreement for one observer over time

Tape	Chi-square Value	d.f.	Chi-square Table Values .05	.01
1	.30	1	3.84	6.64
2	3.13	3	7.82	11.34
3	2.36	3	7.82	11.34

The study of reliability had demonstrated that the investigator could agree with others and, over a period of time, could agree with herself in categorizing cognitive behaviors according to the observational instrument. The investigator was therefore ready to test the instrument by analyzing cognitive behaviors occurring in home economics classrooms as exhibited on videotapes.

Collection of Videotapes

The basis for selecting classrooms to be videotaped was not directly related to this research. The classrooms were selected for research conducted by Mrs. Karen Zimmerman, another doctoral candidate in the Home Economics Education Department at Iowa State University, with the understanding that they would be used for both studies. Her research design demanded a high degree of selectivity concerning classrooms to be visited. Two reasons provide justification for using these same classrooms in the testing of the observational and recording method for analyzing cognitive behaviors exhibited by teachers and students in home economics classrooms. First of all, the process of purchasing 40 videotapes and traveling to all of the

classrooms to record the behaviors was very expensive. Secondly, the objectives of this research did not require that the classrooms be randomly selected. A more complete discussion of the selection of the teachers is given by Zimmerman (1970).

All ninth grade home economics teachers within a radius of approximately 75 miles of Ames, Iowa, with the exception of those in the city of Ames, were contacted and asked to participate in the research. Of these 146 teachers, 126 or 86.30 percent responded by completing the Personal Orientation Inventory, which was relevant only to the Zimmerman study. On the basis of the inner directed scale from this inventory, a measure of self-actualization, the 10 teachers having scores indicating highest degree of self-actualization and the 10 teachers having scores indicating lowest degree of self-actualization were asked to participate in videotaping of home economics classes. Videotapes were made of one of their ninth grade home economics classes on two different days when teacher-pupil discussion was the teaching technique used. Of the 20 teachers contacted, three were unable to participate and were therefore replaced. No teachers were selected who had fewer than nine students in their ninth grade class or whose class period was shorter than 30 minutes. If a teacher taught more than one section of ninth grade homemaking, the teacher was not given a choice of which section would be visited. The section was randomly selected by the investigators.

Forty trips were made to selected classrooms for the purpose of videotaping between January 28, 1970, and April 14, 1970. Except for the first trip the two researchers alternated visits and were accompanied by graduate students or undergraduates preparing for student teaching. The second

visit to a teacher was always made by the same investigator who made the first visit. Equipment belonging to the Home Economics Education Department was used for videotaping.

Much could be written concerning problems and experiences during the visits to the classrooms. Not all schools were equally well equipped to provide the four power outlets needed for the videotape recorder, camera, television monitor, and speaker control. Teachers varied in the degree of ease with which they faced the videotaping experience. School buildings and homemaking departments within these buildings were sometimes difficult to locate. Winter weather was a major problem and contributed to poor driving conditions as well as to cold equipment. When temperatures were at the sub-zero level equipment had to be given at least 10 minutes to warm up when arriving at a school before it would function properly. The videotapes were carried inside the car to prevent them from becoming brittle. Scheduling someone to help load and unload equipment at the beginning and end of a trip was sometimes difficult. However, students were very willing to carry equipment at the high schools while the investigator made contact with a teacher and surveyed the physical lay-out of a classroom or said good-bye. Equipment did not always work but because an audiotape recording of the verbal interaction was also made no trips had to be repeated. A major problem to the research designs was a misinterpretation of the meaning of "classroom discussion". Therefore, in three of the 40 classes the students were given the primary leadership role by the teacher with the result that comparatively little teacher-pupil interaction was exhibited.

Analysis of behaviors

The observational instrument was next tested in recording cognitive behaviors occurring in the 40 ninth grade home economics class sessions as displayed on the videotapes made in these classrooms. A table of random numbers was used to establish the order for viewing and analyzing the 40 videotapes. As a result, the first videotape viewed was made on the second trip to the thirteenth teacher visited. The next videotape viewed was made on the second trip to the second teacher visited. It seemed that this procedure would increase the objectivity of recording. There was no time when the two videotapes made in the same teacher's classroom were viewed in sequence. This lessened the chance of the analysis of the first class session influencing the observer's judgment concerning analysis of the second class session.

Analysis was made of the cognitive behaviors during the entire length of the class discussion. Because classes varied in length, analysis times differed in each of the 40 class sessions. Some interaction analysis systems call for analyzing classroom behaviors only for a specified length of time such as 20 minutes and for beginning analysis after taking a few minutes to become familiar with the setting. However, it was decided that to represent all levels of cognitive behaviors occurring in a class session the behaviors during the introduction and the conclusion needed to be included in the analysis. To illustrate, the first few sentences of the teacher might indicate that the class discussion was a review of previous work. This fact would be important for the observer in categorizing later cognitive behaviors accurately. A rationale for including the final verbal interaction in the analysis was discovered during development of the

instrument. In viewing the videotapes used for establishing observer reliability it was found that if a teacher was going to exhibit behaviors which could stimulate students to respond at the higher cognitive levels, these behaviors were most likely to occur at the very end of a class session.

One tally was made each time a cognitive behavior was exhibited by the teacher or a student; therefore, the total number of behaviors analyzed in different class sessions varied. The decision to make a tally for each behavior instead of for a specified time interval was made in early stages of development of the instrument. The nature of cognitive behaviors seemed to be such that an observer often needed to listen to an extended segment of teacher or pupil behavior before being able to make a tally in the proper category.

After the first 20 of the 40 videotapes had been viewed and the cognitive behaviors recorded using the observational instrument, the reliability of the investigator in reporting behaviors was again studied. A videotape not previously used in the study of observer reliability was selected. One of the observers in the earlier reliability study experienced a brief retraining session. The investigator and this observer then categorized the cognitive behaviors exhibited on the selected videotape and the data were analyzed. A chi-square value of 5.99 at the 5 percent level of significance and 9.21 at the 1 percent level of significance was required to indicate a difference between the two observers in categorizing the cognitive behaviors. The calculated chi-square value was 1.96, indicating that the two observers were agreeing in reporting the observed behaviors.

The investigator viewed the remaining 20 videotapes and recorded the cognitive behaviors exhibited. The tally sheets on which the data were

recorded were sent directly to a key punch operator for making a data deck to be used in the organizing and statistical analysis of the data by computer.

Study of data

The tallying procedure for the observational instrument supplied data concerning the kind and number of cognitive behaviors for teachers and students exhibited during two visits to each of 20 classrooms. The data were studied to provide information for answering three questions:

Question one: With what frequencies were the six levels of cognitive behaviors and the total of all cognitive behaviors exhibited by teachers and students in the selected ninth grade home economics classrooms as shown by application of the observational method?

Question two: What relationships existed between the stimulation of cognitive behavior by teachers and the response by students in the selected ninth grade home economics classrooms as shown by application of the observational method?

Question three: Did the observational method, when applied in analyzing cognitive behaviors in the selected ninth grade home economics classrooms, discriminate among the 20 different classrooms on each of the six different cognitive behaviors and on the total of all cognitive behaviors for teachers and for students?

Question one To answer the first question concerning frequencies of the six levels of cognitive behaviors and the total of all cognitive behaviors exhibited by teachers and students, counts were made in each of the six categories of behaviors separately for teachers and for students. The

frequency counts were used to give the following information:

a) the mean frequencies for the two observations in each of the 20 classrooms for the six levels of behaviors of teachers and students,

b) the mean frequencies for the total of 40 observations in the 20 classrooms for the six levels of behaviors of teachers and students,

c) the mean frequencies for the two observations in each of the 20 classrooms for the total of all behavior pairs of teachers and students.

Teachers and students varied in the ratios between the levels of cognitive behaviors exhibited in classrooms, a fact not clearly presented by the raw data for purposes of comparing one teacher or class session with another because of a variation in the total number of behaviors. It seemed that the distribution among the levels of behaviors was more important than the number of tallies at any one level in the development of cognitive skills. For example, Teacher A may stimulate 200 cognitive behaviors, of which 10 are in category five, generalize or create. Teacher B may stimulate 50 cognitive behaviors with 10 in category five, generalize or create. To more accurately describe what each teacher is doing in developing cognitive skills in the classroom the percentages for these data must be studied. Teacher B, even though exhibiting fewer behaviors, is concentrating more of her total effort in developing cognitive skills at the higher levels. It cannot be said that Teacher B, with 20 percent of her total behaviors in category five, is stimulating better learning in students than Teacher A, with 5 percent of her behaviors in category five. However, this information, when combined with other kinds of data by the teacher or by a supervisor or researcher, may develop more meaning concerning the effectiveness of the

teaching involved. Due to this rationale the information concerning the six levels of cognitive behavior and the total of all behaviors was also analyzed in terms of percentages.

Class discussions varied in length for a number of reasons such as the desire of the teacher, the school schedule, and problems related to the videotape equipment. It seemed that a different relationship among the data for the different class sessions might occur if length of time was standardized; therefore, the raw frequencies were equated on the basis of time to indicate the frequencies for the six levels and for the total of all cognitive behaviors if all class sessions had lasted 60 minutes. This was based on the assumption that the rate of occurrence of the levels of behaviors would remain constant over the 60-minute period. Data could have been equated on the basis of one minute, 30 minutes or some other time length. Sixty minutes was selected because it seemed logical for classroom situations, was an easy number to use in calculations, and exceeded by one minute the longest classroom discussion which actually occurred.

Question two To answer the second question concerning the relationships between stimulation by the teacher and response by the student the data were recorded on matrices. The directions for using the observational system were such that behaviors were categorized to give a teacher-pupil pair. The category for the teacher and for the pupil in each pair was used to enter the pair of behaviors in a cell of a 6-row by 6-column matrix. This was done to give a frequency count of behavior pairs for each of the 36 cells of the matrix. The frequency counts for the 36 behavior cells were obtained for each of the 20 classrooms and for the total of 40 observations in the 20 classrooms. The data for the cells of the matrices were converted

to percentages but were not converted to equated frequencies.

Relationships between the cognitive behaviors of teachers and students were also studied by determining the number and the percentage of the behavior pairs falling into three areas of the matrix: A, the diagonal area indicating a pupil response at the same level of cognitive behavior as the teacher stimulation; B, the area below the diagonal indicating a pupil response at a lower cognitive level than the teacher stimulation; and C, the area above the diagonal indicating a pupil response at a higher cognitive level than the teacher stimulation. This determination of frequencies and percentages for the behavior pairs in the three matrix areas was made for each of the 20 classrooms and the total of 40 observations in the 20 classrooms.

Question three The third question was answered by determining the ability of the observational instrument to discriminate among the 20 classrooms on each of the six different cognitive behaviors for teachers and for students and on the total number of behavior pairs tallied for each of the 20 classrooms. This was done by a single classification analysis of variance using a fixed effects model (Snedecor and Cochran, c1967, p. 275). The analyses of variance among the 20 classrooms for each level of behavior were calculated using raw frequencies, equated frequencies, and percentages. The analyses of variance among the 20 classrooms for the total number of behavior pairs were calculated using raw frequencies and equated frequencies.

THE BRUN COGNITIVE INTERACTION SYSTEM

This chapter contains the instrument developed for observing and recording one kind of classroom interaction between teachers and their students. Verbal teaching behaviors that may stimulate students' cognitive responses and the responses made by students as a result of the stimulation by the teacher are the focus of the observational and recording method.

Descriptions for each of the categories of cognitive behavior are found in the first section of the chapter. Directions for using the instrument are given in the next section of the chapter. The last section contains examples of teacher-pupil classroom interaction and a discussion of the tallies made for the behaviors of teachers and students.

Definition of Categories for Teachers and Students

The definitions of the six levels of cognitive behavior for teachers and for students are as follows:

0. Unrelated behavior (teacher)

The teacher makes no verbal statement, either immediately preceding a cognitive response by a student or at an earlier time in the class session, which stimulates the cognitive response made by the student. In other words, the student exhibits a cognitive behavior for some other reason than that the teacher stimulates that behavior.

0. Unrelated behavior (student)

The student responds to cognitive stimulation by the teacher in a manner other than that which indicates any cognitive behavior has occurred. The student response is made in one of the following ways: a) by silence, b) by a verbal statement in which no cognitive thinking is involved, c) by

an answer unrelated to the teacher's stimulation, d) by stating that he does not know the answer or, e) by stating that he does not understand or hear the teacher's stimulation.

1. Recall or obtain information (teacher)

The teacher makes a statement or asks a question that stimulates students to bring to the conscious level that information which a) is stored in the student's mind or b) can be comprehended through the student's senses. The teacher may be referring to material covered in previous classes or to facts and ideas which students can be assumed to have experienced or observed and stored as a result of everyday living.

The student's senses of sight, hearing, smell, taste and touch might separately or collectively be stimulated by the teacher to help the students a) recall information previously stored in the mind or b) bring to the conscious level what can easily and quickly be known without using higher mental processes. Here the concern is with specific or concrete information rather than with abstract feelings, suppositions or intuitions.

In questioning, the teacher might begin with how, what, who, where, when. In stimulating student understanding by using the senses, the teacher might direct the students to a chart, an audiotape, a piece of fabric, the blackboard or reading in a text where students can directly obtain the information.

To be included in this category are teacher behaviors involved with asking a student to repeat an answer and asking the student to react to the teacher's exploratory shortening of an answer which a student has given. These are low level recall behaviors.

1. Recall or obtain information (student)

The student responds with information which a) is stored in the student's mind or b) can be comprehended through the student's senses. This includes recalling or bringing to the conscious level material covered in previous classes. It also includes observations, perceptions, facts and ideas the students can be assumed to have experienced and stored as a result of everyday living.

The student may be using his senses of sight, hearing, smell, taste and touch, either separately or collectively to a) recall information or b) bring to the conscious level what can easily and quickly be known without using higher mental processes. The response of the student is concerned with specific or concrete information rather than with abstract feelings, suppositions or intuitions.

The student's response might commonly be to a teacher's question that begins with how, what, who, where, when. Student's responses might also be the result of a teacher's directive to study a chart, an audiotape, a piece of fabric, the blackboard or certain portions of a text where students can directly obtain information.

To be included in this category are students' behaviors involved with repeating an answer or shortening an answer already given. These are low level recall behaviors.

2. Use or select and apply knowledge (teacher)

The teacher makes a statement or asks a question that stimulates students to utilize or put into practice information or knowledge already recalled or obtained. The teacher stimulates students to bring to bear the appropriate facts, generalizations or principles. This stimulation by the

teacher may occur in two different ways, a) the teacher indicates the knowledge which the student is then to use in a particular situation or b) the teacher expects the student to select the appropriate facts, generalizations or principles which the student is then to apply to the situation or problem needing attention.

At this level it is assumed that the knowledge has already been learned and that the student must only recall it or be reminded of it by the teacher before applying it. Therefore, some behaviors from category one, recall or obtain information, are involved but only to facilitate the occurrence of category two, use or select and apply knowledge. The teacher does not demonstrate how to use the knowledge at this level of behavior.

2. Use or select and apply knowledge (student)

The student response indicates that he is utilizing or putting into practice information or knowledge he can recall or has previously obtained. The student brings to bear the appropriate facts, generalizations or principles upon a situation or problem needing attention.

The student himself may select from his past knowledge the facts, generalizations or principles he is to apply or he may apply knowledge which the teacher has indicated for the particular situation. However, it is assumed at this level that the student has already learned the information and must only recall it or be reminded of it by the teacher before applying it. The student is not shown how to use the knowledge at this level of cognitive behavior.

3. Analyze, compare, contrast (teacher)

The teacher makes a statement or asks a question that stimulates students to separate material or information so that the constituent parts or

characteristics are apparent. In this category also are those teacher's behaviors that stimulate students to a) detect the similarities and/or differences involved in material or information or b) detect relationships among the constituent parts of the material or information.

Analyses, comparisons and contrasts may be stimulated by the teacher to occur within a framework or system indicated by the teacher or the student may provide the framework or system. This framework or system may or may not be evident to the observer.

3. Analyze, compare, contrast (student)

The student response indicates that he is separating material or information so that the constituent parts or characteristics are apparent. In this category also are those behaviors demonstrating that the student has a) detected the similarities and/or differences involved in material or information or b) detected relationships among the constituent parts of the material or information.

The framework or system used by the students to make analyses, comparisons and contrasts may have been provided by the teacher or by the student himself. The framework or system may or may not be evident to the observer.

4. Judge, evaluate, determine significance (teacher)

The teacher makes a statement or asks a question that stimulates students to a) make a judgment, b) evaluate or c) determine the significance of something. The judgment, evaluation or determination of significance may be stimulated in relation to products, methods, ideas, or feelings. The criteria to be used may be stated or implied by the teacher. At other times the teacher may expect the student to select the criteria to be used. Included in this category are stimulations by the teacher which indicate that

the student is to make a judgment concerning the value of the product, method, idea or feeling or to select among alternatives on the basis of value.

It is not always clear whether the teacher is merely stimulating recall of past discussions or experiences, category one, or truly stimulating a judgment, category four. At this point the observer must make a decision based on what is known about previous lessons or about general knowledge students can be assumed to have.

For the purposes of this instrument we do not exclude those stimulations by the teacher which do not call for reason or justification for the decision. Judgments, evaluations and determinations of significance, with or without the inclusion of the reason for the decision, are tallied in category four.

4. Judge, evaluate, determine significance (student)

The student responds with verbal behavior that shows he is a) making a judgment, b) evaluating or c) determining significance. This level of behaviors may be exhibited in relation to products, methods, ideas or feelings. The student may know and select the criteria to be used or the criteria may have been stated by the teacher. Included in this category are verbal responses of students which indicate that a judgment concerning the value of the product, method, idea or feeling has been made. Also included are those responses which show that a student has selected among alternatives on the basis of value. The student's responses do not necessarily include an explanation of the reason or justification on which the judgment, evaluation or determination of significance is based.

It is not always clear whether the student is recalling past

discussions or experiences, category one, or truly making a judgment, category four. The observer must make a decision based on what is known about previous classroom experiences or about general knowledge students can be assumed to have.

5. Generalize or create (teacher)

The teacher makes a statement or asks a question that stimulates students to a) put together the parts to make a whole that is meaningful or b) formulate a principle or generalization that covers similar situations or circumstances. This behavior may occur at the end of a class discussion or at the end of one segment of a discussion when the teacher stimulates students to generalize or synthesize in relation to the topic under discussion.

The kind of behavior included in category five does not assume that the teacher is stimulating original creativity in the sense that she is expecting a response never before given. The teacher is, however, stimulating behavior that is new and original to the student or students in the particular situation being observed. This category implies something the student has not seen or done before. A review that occurs at the end of a lesson is not categorized at this level of cognitive behavior.

5. Generalize or create (student)

The student responds to the stimulation of the teacher by a) putting together the parts to make a whole that is meaningful or b) formulating a principle or generalization that covers similar situations or circumstances. These behaviors may occur at the end of a class discussion or at the end of one segment of a discussion.

The behavior of the student does not have to be exhibiting original

creativity in the sense the response has never before been given. The student is, however, exhibiting behavior that is new and original to him. This category implies something the student has not seen or done before. Review statements at the end of a lesson are not tallied as category five behaviors.

Directions for Using Instrument

The directions for using the observational and recording method for cognitive behaviors are as follows:

Direction one

Behaviors are recorded on a tally sheet (Appendix F) in pairs with a tally for the teacher followed by a tally for the student. The behavior pairs are recorded in a 35-row column. When the last pair in a column is tallied the observer starts again at the top of the page in a new column. There are four columns on a tally sheet; therefore, 140 behavior pairs may be recorded on a sheet. If one sheet is filled another sheet is used. Tallying begins by recording a category number, zero through five, for a behavior of the teacher and this is followed by recording a category number, zero through five, for the resulting student response. This sequence is maintained and the observer ends with a student response.

Direction two

There are times during classroom interaction when behaviors do not obviously indicate a teacher-pupil sequence of tallies. Students sometimes exhibit behavior in the classroom that is cognitive in nature but has not been immediately preceded by a stimulation of the teacher. At other times a teacher may stimulate a cognitive behavior at one level and before any student response has occurred may stimulate a behavior at yet another level.

In order to maintain the teacher-pupil sequence of tallies special procedures need to be followed to determine the category to be tallied in the empty space.

If a student behavior is exhibited and the observer has observed no teacher stimulation then or at an earlier point in the lesson which prompted the student behavior a tally of zero is made for the teacher. In developing and testing the instrument a teacher behavior of zero was tallied only once; therefore, the situation described is very rare.

Another situation may occur where no teacher behavior immediately precedes a cognitive response by the student but where the stimulation by the teacher has occurred at an earlier time in the lesson. The procedure is to record a tally for the teacher which corresponds to the original stimulation by the teacher. An observer may leave a blank at the time and go back later to determine the category. However, in developing and testing the instrument it seemed easy and convenient to make the teacher tally immediately after the tally of the student behavior was made. It was not difficult to recall an earlier teacher behavior related to the student response.

A third situation in which cognitive stimulation of the teacher does not precede a tally for the student occurs when more than one student responds to an original stimulation by the teacher, when one student exhibits more than one level of cognitive behavior in a response and therefore receives more than one tally, or when a teacher simply mentions a different student's name preceding another student response. In this situation a tally for the teacher to correspond with each tally for the student is made and corresponds to the original stimulation by the teacher. It is assumed that any subsequent student responses are promoted by the original question

or statement.

There are occasions when a teacher exhibits cognitive stimulation at another level before giving students time to respond to the original stimulation. To maintain the teacher-pupil sequence a zero is tallied for the student on such occasions indicating no response was made.

Direction three

Categorize only verbal teaching behaviors that stimulate student cognitive responses except when no teacher stimulation to a student response has occurred and the teacher category zero is used. Likewise, categorize only verbal student responses to stimulation by the teacher except for the occasions calling for the use of the student category zero. Since the instrument was originally developed for the observation of teaching behaviors which stimulate student cognitive behavior, observation of both verbal and nonverbal behavior was attempted. However, the observers encountered a lack of agreement concerning which non-verbal behaviors stimulated student cognitive behavior. It appeared that each teacher observed had developed an individual style of nonverbal behaviors which her students had learned to "read". The judges, being unfamiliar with her style, had difficulty reaching agreement on the meaning of those nonverbal behaviors. Therefore, to provide for greater agreement among observers and facilitate categorizing behaviors as clear and distinct categories, it was decided to limit the analysis to verbal teaching behavior.

Direction four

When deciding upon a tally for a teacher stimulation, the observer will categorize the level of cognitive process students will be expected to exhibit as a result of the behavior of the teacher. This emphasis

differs from many observation systems which discriminate among teaching behaviors in terms of their actual manifestation, not in terms of this manifestation's expected effect upon student behavior or responses.

Direction five

Make a tally for each separate cognitive behavior. A method of tallying approximately every three seconds was investigated and found to be too demanding when the observer is trying to make fine discriminations among five categories of one kind or class of teaching behavior. A simple frequency count of the number of behaviors in each category was next studied and was found to be much more feasible for the observer. However, the sequence of behaviors was lost when this method was used. Therefore, the present method using a tally for each behavior but preserving the sequence of behaviors was adopted.

Direction six

In reading the definition of the categories one must remember that not all the kinds of behavior described in a definition need to be happening for that category to be tallied. For example, at the recall level a teacher may be stimulating a student to recall information from a previous lesson but not stimulating the student to comprehend something which appears on a chart.

Direction seven

Facilitating behaviors occurring in the classroom are not analyzed unless they stimulate student cognitive behaviors. For example, if the teacher asks students to open their books to page 73, appoints someone to take roll or directs a student to thread the movie projector, no cognitive behavior has been stimulated. However, if the teacher asks students to

read from page 73 to 80 she is stimulating cognitive behavior in category one, recall or obtain information. If the teacher asks students to select examples of children's social development from a film, she is stimulating cognitive behavior in category three, analyze-compare-contrast.

Direction eight

When using this observational instrument the observer is not to be concerned with the correctness of teacher and student cognitive behaviors. It is not the purpose of this instrument to be concerned with an evaluation of accurateness and perfection in subject matter content as being transmitted in the schools.

Examples of Behaviors and Tallies Made

Examples of interaction between teachers and pupils were taken from videotapes made in home economics class sessions. These appear below along with an explanation of the tallies that would be made for the behaviors in the examples.

T -- Well, I think that we probably have lots of good points here that we can use. A lot of these can be used in other situations too, can't they.

S -- (Silence, some shake heads).

Here the teacher is giving information to the students. The question is rhetorical and does not require an answer from students. This behavior is often exhibited by teachers who are attempting to be democratic or accepting of students. A tally for category one would be made for the teacher followed by a tally for category zero for the student.

T -- You can use this dusting as a time to get exercise. I'm sure a lot of

us feel we don't get enough exercise walking to school and back.

S -- Sure, I use the sponge to mop the floor with because I need the exercise, not an easier way to do it.

Here is an example of a stimulation by the teacher which is not in the form of a question. The teacher is stimulating recall of student feelings, category one. The student responds by relating or recalling personal experiences, also category one.

T -- You probably have certain ideas about how fellows should act. How would you like a fellow to act if he should ask you for a date?

S -- Well, I've never liked being asked just if I was busy on a certain night because that kind of puts you on the spot if you don't want to go out with him, really.

The teacher's stimulation and student's response are both at the recall level, category one. The teacher expects that the students have already obtained ideas from previous experiences or observations. The student who responds does refer to previous experiences and the ideas which were formed as a result of these experiences.

T -- How or where might a boy ask a girl for a date? Becky.

S -- Well, I think most boys call girls up on the phone because they're kind of afraid, unless they're going together, to ask her in the hall at school, because if she turned him down everyone would hear.

Here the teacher asks a question which stimulates students to bring to the conscious level that information which students can be assumed to have experienced or observed and stored as a result of everyday living, category one. The student responds at this same level but then expands the answer by evaluating or determining the significance of her own answer. Therefore,

the student would receive a tally in category one and in category four. A teacher tally in category one would need to be added in between the two student tallies, referring back to the original teacher stimulation.

T -- Now, which of these resources would you change to reach your goal of saving time? Belinda.

S -- Time and energy?

T -- Okay. You want to save time. How are you going to do it?

S -- Become more efficient?

The teacher is asking students to select the appropriate resource from the list they have already made, category two. The student responds at the same level. The teacher asks for a further explanation of how the student would apply her knowledge, category two. The student again responds with behavior to be tallied in category two.

T -- Janice, how would you place these accessories on a mantle so that formal balance is achieved?

S -- I would place the clock in the center with a candle on each side.

The principle of formal balance has been previously discussed. Now the teacher is asking the student to apply the knowledge, category two. The student responds at the same level, category two.

T -- in a few minutes we are going to go around the room and I'm going to ask each of you to tell me whether your material has any characteristics that require special lay-outs.

S -- (Silence).

The teacher is asking the students to apply knowledge they have acquired earlier, category two. At this time the student category zero is tallied. Later, when the teacher "goes around the room" calling on each

girl by name, category two will still be used for the teacher because the earlier teacher behavior was the actual stimulation for the student responses.

T -- If you change in one area will you affect another area? For instance, if you decide that you're going to use your dusting as a time for exercise, do you want to buy a vacuum cleaner to save time?

S -- (No time for student response).

T -- Okay, not necessarily.

S -- (Silence).

The teacher is stimulating students to detect relationships among constituent parts, category three. However, she does not give time for any student response before her next remark. A student tally of zero is made. The teacher then gives information, category one, followed by student silence, category zero.

T -- Can you see advantages or disadvantages to either of these for saving time? (Shows vacuum cleaner and dusting cloth).

S -- It depends on what the job is.

S -- There are places you can get with a dust cloth and not a vacuum cleaner and vice versa.

The teacher is asking students to compare the vacuum cleaner with the dusting cloth for a specific situation, saving time. This behavior is in category three. Both student responses are also in category three, the first one detecting relationships among jobs, the second detecting differences. A tally for the teacher in category three needs to be inserted in between the two student tallies, referring back to the original teacher stimulation.

T -- I'll give you just a few moments and why don't you think about what went on during this little skit and then we'll discuss these points. So you think about it for just a minute.

S -- (Silence).

In this teacher statement it appears that the teacher is simply asking the students to recall what happened in the skit. However, because she adds that the points will be discussed and because she gives them time to think about it, the behavior we would expect the students to exhibit is category three, to separate the material or information so that the constituent parts or characteristics are apparent. The teacher's behavior would be tallied in category three. The student's behavior at this point would be in category zero because there is silence. The observer may need to refer back to this original teacher behavior when students begin discussing points about the skit.

T -- How soon should a girl tell him that she can go to the sock hop with him on Friday?

S -- Well, I think Wednesday might be soon enough because he might have to get the car, although something like that isn't as crucial as the prom, but she should let him know as long as he called on Monday.

The teacher question stimulates students to make a judgment or an evaluation and is tallied in category four. The student responds at the same level by making a judgment in selecting among the alternatives on the basis of value and deciding upon Wednesday. A reason for this choice is given by her.

T -- If you were a boy, how would you feel about a girl answering you in this way?

S -- Well, I'd feel kind of hurt like I wasn't good enough for her. She didn't sound very enthusiastic about going out with him.

The teacher asks a question which stimulates the student to evaluate feeling, category four. The student answers at the level stimulated by the teacher, category four, by stating her evaluation of how the boy would feel and in this example does give a reason or justification for the evaluation she made.

T -- We have been discussing the observations we made in the classes for the mentally retarded. From all the comments made what could you say is the main goal of the teachers in these classes?

S -- They are trying to help the students to take care of themselves when they grow up.

The teacher is asking a question that stimulates students to formulate a principle or statement that covers the situations observed in several different classrooms, category five. A student responds at this same level with an answer that is new and original to him as far as the observer can tell.

TEST OF INSTRUMENT IN ANALYZING CLASSROOM BEHAVIORS

To test the observational and recording method in analyzing classroom cognitive behaviors, the method was applied in tallying cognitive behaviors in home economics classrooms as displayed on videotapes. Videotapes were made of one of the ninth grade classes of 20 selected home economics teachers on two different days when teacher-pupil discussion was the teaching technique used. This resulted in a collection of the cognitive behaviors occurring in 40 different class sessions.

The data supplied by the tallying of behaviors were studied concerning the frequencies for the six levels and totals of cognitive behaviors, the relationships between behaviors of teachers and students, and the ability of the method to discriminate among classrooms. Three questions were asked in regard to these studies.

Question One

With what frequencies were the six levels of cognitive behaviors and the total of all cognitive behaviors exhibited by teachers and students in the selected ninth grade home economics classrooms as shown by application of the observational method? To answer the first question, counts in each of the six categories of behaviors for teachers and for students were made. The behaviors from the two class sessions for each teacher and each group of students were added together. From these sums the mean raw frequencies per classroom, the equated frequencies, and the percentage distributions were calculated. The equated frequencies were computed on the basis of the total time for the two sessions and are given for the expected number of frequencies in a 60-minute class session.

The mean frequencies and percentages for each level of behavior appear in the first two tables with teachers and students given separately. The third table related to the first question presents the mean frequencies for the two observations in each of the 20 classrooms for the total of all behavior pairs of teachers and students. Since the tallying procedures give rise to an equal number of total behaviors for teachers and for students, teachers and students are not treated separately in this table. Percentages for total behaviors, all of which would be 100 percent, are not included.

Teacher behaviors

The data concerning mean frequencies and percentages for the categories of cognitive behavior for teachers are reported in Table 5. No tallies were made in category zero, unrelated behavior, during any of the 40 class sessions; therefore, this category of behavior has not been included in the table. All 20 teachers stimulated cognitive behaviors in category one, recall or obtain information, and in category two, use or select and apply knowledge. Nineteen of the 20 teachers stimulated cognitive behaviors in category three, analyze-compare-contrast, and 17 teachers exhibited behaviors which were tallied in category four, judge-evaluate-determine significance. Tallies were made for the fewest number of teachers in category five, create or generalize. In this highest level of cognitive stimulation only nine of the 20 teachers exhibited any behaviors as tallied by the investigator. It can be concluded that, with the exception of category zero, all levels of cognitive behavior were stimulated in the total of all classrooms observed but that all the five levels of cognitive behavior were not stimulated by each of the 20 teachers. Only nine of the 20 teachers

Table 5. Raw and equated frequencies and percentages for the five cognitive behaviors tallied for teachers

Teacher	Type of Data[a]	Category of Behavior				
		1	2	3	4	5
1	R	146.0[b]	18.0	5.5	--	--
	E	171.8[b]	21.2	6.5	--	--
	%	86.1	10.6	3.2	--	--
2	R	61.5	24.0	17.0	1.5	0.5
	E	110.1	43.0	30.4	2.7	0.9
	%	58.9	23.0	16.3	1.4	0.5
3	R	47.0	9.0	1.5	2.0	--
	E	108.5	20.8	3.5	4.6	--
	%	79.0	15.1	2.5	3.4	--
4	R	89.0	34.0	7.5	1.5	--
	E	138.7	53.0	11.7	2.3	--
	%	67.4	25.8	5.7	1.1	--
5	R	59.0	17.5	20.5	1.0	2.5
	E	97.0	28.8	33.7	1.6	4.1
	%	58.7	17.4	20.4	1.0	2.5
6	R	110.0	44.0	38.5	2.5	1.0
	E	154.9	61.4	53.7	3.5	1.4
	%	56.4	22.3	19.5	1.3	0.5
7	R	47.5	21.0	27.0	9.0	3.0[b]
	E	76.0	33.6	43.2	14.4	4.8[b]
	%	44.2	19.5	25.1	8.4	2.8[b]
8	R	61.5	13.0	19.0	4.0	--
	E	115.3	24.8	35.6	7.5	--
	%	63.1	13.3	19.5	4.1	--
9	R	88.5	16.0	22.0	9.5	0.5
	E	102.1	18.5	25.4	11.0	0.6
	%	64.8	11.7	16.1	7.0	0.4
10	R	67.5	13.0	22.5	2.5	0.5
	E	102.5	19.7	34.2	3.8	0.8
	%	63.7	12.3	21.2	2.4	0.5

[a]R = raw frequencies, E = equated frequencies, % = percentages.

[b]High point of range.

Table 5. (Continued)

Teacher	Type of Data	Category of Behavior				
		1	2	3	4	5
11	R	40.5	26.5	27.5	4.5	--
	E	51.2	33.5	34.7	5.7	--
	%	40.9	26.8	27.8	4.6	--
12	R	64.0	20.5	13.0	1.0	--
	E	112.9	36.2	22.9	1.8	--
	%	65.0	20.8	13.2	1.0	--
13	R	64.5	64.5[b]	54.0[b]	6.5	--
	E	89.0	89.0[b]	74.5[b]	9.0	--
	%	34.0[c]	34.0	28.5	3.4	--
14	R	83.0	16.5	48.0	14.0[b]	--
	E	87.4	17.4	50.5	14.7	--
	%	51.4	10.2	29.8[b]	8.7	--
15	R	67.5	27.0	12.5	12.0	1.0
	E	87.1	34.8	16.1	15.5	1.3
	%	56.3	22.5	10.4	10.0	0.8
16	R	37.0	28.0	23.0	4.0	--
	E	60.8	46.0	37.8	6.6	--
	%	40.2	30.4	25.0	4.4	--
17	R	94.0	9.5	5.5	--	--
	E	137.6	13.9	8.0	--	--
	%	86.2[b]	8.7	5.1	--	--
18	R	37.5	10.5	--[c]	--	--
	E	66.2	18.5	--[c]	--	--
	%	78.1	21.9	--[c]	--	--
19	R	38.5	35.0	5.5	1.0	--
	E	73.3	66.7	10.5	1.9	--
	%	48.1	43.8[b]	6.9	1.3	--
20	R	30.0[c]	2.5[c]	7.0	11.0	1.0
	E	50.0[c]	4.2[c]	11.7	18.3[b]	1.7
	%	58.3	4.9[c]	13.6	21.4[b]	1.9
Total	R	66.8	22.5	18.9	4.4	0.5
	E	100.5	33.9	28.4	6.6	0.8
	%	59.1	19.9	16.7	3.9	0.4

[c]Low point of range.

exhibited behaviors which were tallied in all five categories.

In category one, recall or obtain information, the mean number of behaviors for each teacher ranged from 30.0 to 146.0 with a mean for the total for 20 teachers of 66.8 behaviors. One factor contributing to the range may have been that Teacher 20, with 30.0 behaviors, had an average length for each of her two class sessions of 36 minutes while Teacher 1, with 146.0 behaviors, averaged 51 minutes for each of her two class sessions. However, in this case the mean equated frequencies corrected for the differences in time indicate that the same two teachers are contributing to the range in this type of data, Teacher 20 with 50.0 behaviors and Teacher 1 with 171.8 behaviors. The total mean frequency for the equated data is 100.5 behaviors. Percentages for category one show a range for the 20 teachers of 34.0 percent for Teacher 13 to 86.2 percent for Teacher 17, with an overall average of 59.1 percent.

In category two, use or select and apply knowledge, the mean number of behaviors for all teachers was 22.5, with a range of 2.5 behaviors for Teacher 20 to 64.5 behaviors for Teacher 13, the only teacher who exhibited behaviors in categories one and two with equal frequency. When equated on the basis of time, the mean frequency for all teachers was 33.9, with a range of 4.2 for Teacher 20 to 89.0 for Teacher 13. Percentages ranged from 4.9 percent for Teacher 20 to 43.8 percent for Teacher 19 with an average of 19.9 percent.

In category three, analyze-compare-contrast, no behaviors were tallied for one of the 20 teachers; therefore, the behaviors ranged from a mean of 0.0 for Teacher 18 to a mean of 54.0 for Teacher 13. The mean frequency for all teachers was 18.9 behaviors. When equated on the basis of time, the

mean frequency for all teachers was 28.4 with a range of 0.0 for Teacher 18 to 74.5 for Teacher 13. The average percentage of behaviors in category three for all teachers was 16.7 percent with a range of 0.0 percent for Teacher 18 to 29.8 percent for Teacher 14.

In category four, judge-evaluate-determine significance, three of the 20 teachers did not exhibit behaviors which the investigator judged to be stimulating cognitive responses for students. Behaviors ranged from 0.0 for Teachers 1, 17, and 18 to 14.0 for Teacher 14, with a mean frequency for all teachers of 4.4 behaviors. Equating the frequencies on the basis of time indicated a total mean frequency of 6.6 behaviors, with a range of 0.0 for the three teachers who received no tallies to 18.3 for Teacher 20. Category four had 3.9 percent of the total tallies with a range of 0.0 for three teachers to 21.4 percent for Teacher 20.

In category five, generalize or create, only nine of the 20 teachers exhibited behaviors judged to be stimulating student responses. The highest mean number for a teacher was 3.0 behaviors for Teacher 7 and the mean for the total of all teachers was 0.5 behaviors. When equated on the basis of time Teacher 7 had 4.8 behaviors, and the mean for the total was 0.8. Category five had 0.4 percent of the total tallies, Teacher 7 again at the top of the range with 2.8 percent of her behaviors in this category.

The mean frequencies and the percentages for the total of all teachers in each of the five categories clearly indicate that the categories, when placed in the hierarchical order of one through five, were used with decreasing frequency. This fact provides support for the idea that a hierarchy of behaviors does indeed exist. The lowest level of cognitive behavior, category one, was stimulated most frequently in the home economics

classroom discussions observed, with three times more tallies in this category than in the next highest, category two. This is consistent with research findings of others reviewed earlier (Pfeiffer and Davis, 1965; Davis and Hunkins, 1966; Davis and Tinsley, 1967; Farley and Clegg, 1969; Doak, 1970).

For purposes of comparing teachers or class sessions concerning behaviors recorded on the basis of the observational instrument it is helpful to present the data in terms of raw frequencies, equated frequencies, and percentages. A teacher who stimulated the most or the fewest behaviors in a category on the basis of raw frequencies was not always the same teacher who was at the top or bottom of the range when equated frequencies were considered (Teachers 14 and 20, category four) and was even less frequently the same teacher who had the highest or lowest percentage of behaviors. The basis for deciding which kind of data is most valuable must depend upon the objectives or the research design involved in the use of the instrument. In this research, because the objective is simply to test the instrument in situations similar to those for which it was designed there is no basis for deciding which type of data is most valuable.

It is interesting to note how the position of a teacher in the range for one category of behavior affected her position in the range for other categories. For example, Teachers 1 and 17, with most behaviors in category one, were quite far below the overall means for behaviors in categories two and three and exhibited no behaviors in categories four and five. An example of a trend in the opposite direction is found for Teachers 13 and 20. Teacher 13 had a low percentage of behaviors in category one but was at the top of the range in categories two and three in both raw and equated

frequencies. Teacher 20 was at the bottom of the range in the first two categories in raw and equated frequencies but was highest of all the teachers in category four in both equated frequencies and percentages. These kind of trends are to be expected when percentages are used. However, the raw and equated frequencies also indicate that a tendency to exhibit many behaviors in any one category reduces the likelihood of using other categories. The system of observation provides for the potential utilization of all categories in proportions determined by the teacher. The fact that such a high proportion of tallies were in category one provides important clues for teachers and for teacher educators in efforts to improve teaching behavior.

Student behaviors

The data concerning mean frequencies and percentages for the levels of cognitive behaviors for students are reported in Table 6. This table differs from the preceding one for teachers because it includes a column for category zero. Tallies were made for students in category zero, unrelated behavior, in all 40 class sessions. The number of classrooms in which student behaviors were tallied is the same as for teachers in categories one, two, three, and four. In category five, where nine teachers exhibited behaviors, students of only seven of these nine teachers exhibited behaviors at this level.

The ranges and means for the categories of behaviors in Table 6 are very similar to those in Table 5. Instead of describing these ranges and means in detail, a discussion of the similarities and differences for the two sets of data seems more valuable.

Table 6. Raw and equated frequencies and percentages for the six cognitive behaviors tallied for students

Students	Type of Data[a]	Category of Behavior					
		0	1	2	3	4	5
1	R	20.5	132.0[b]	12.0	5.0	--	--
	E	24.1	155.3[b]	14.1	5.9	--	--
	%	12.1	77.9	7.1	3.0	--	--
2	R	3.5[c]	60.0	22.5	16.5	1.5	0.5
	E	6.3	107.5	40.3	29.6	2.7	0.9
	%	3.4[c]	57.4	21.5	15.8	1.4	0.5
3	R	8.5	40.5	7.0	1.5	2.0	--
	E	19.6	93.5	16.2	3.5	4.6	--
	%	14.3	68.1	11.8	2.5	3.4	--
4	R	6.5	85.5	32.0	6.5	1.5	--
	E	10.1	133.2	49.9	10.1	2.3	--
	%	4.9	64.8	24.2	4.9	1.1	--
5	R	15.0	45.0	16.5	19.5	2.0	2.5[b]
	E	24.7	74.0	27.1	32.1	3.3	4.1[b]
	%	14.9	44.8	16.4	19.4	2.0	2.5[b]
6	R	17.0	103.5	41.0	32.5	2.5	0.5
	E	23.7	144.4	57.2	45.4	3.5	0.7
	%	8.6	52.5	20.8	16.5	1.3	0.3
7	R	7.5	44.0	18.5	28.5	8.0	1.0
	E	12.0	70.4	29.6	45.6	12.8	1.6
	%	7.0	40.9	17.2	26.5	7.4	0.9
8	R	21.5	49.0	12.0	12.0	3.0	--
	E	40.3[b]	91.9	22.5	22.5	5.6	--
	%	22.1[b]	50.3	12.3	12.3	3.1	--
9	R	12.5	80.0	14.5	19.5	9.5	0.5
	E	14.5	92.7	16.8	22.6	11.0	0.6
	%	9.2	58.6	10.6	14.3	7.0	0.4
10	R	4.5	62.5	12.5	24.0	2.5	--
	E	6.8	94.9	19.0	36.5	3.8	--
	%	4.3	59.0	11.8	22.6	2.4	--

[a]R = raw frequencies, E = equated frequencies, % = percentages.

[b]High point of range.

[c]Low point of range.

Table 6. (Continued)

Students	Type of Data[a]	Category of Behavior					
		0	1	2	3	4	5
11	R	4.5	36.0	27.5	26.5	4.5	--
	E	5.7[c]	45.5	34.7	33.5	5.7	--
	%	4.6	36.4	27.8	26.8	4.6	--
12	R	12.0	54.5	19.5	11.5	1.0	--
	E	21.2	96.2	34.4	20.3	1.8	--
	%	12.2	55.3	19.8	11.7	1.0	--
13	R	13.5	57.0	60.5[b]	52.0[b]	6.5	--
	E	18.6	78.6	83.5[b]	71.7[b]	9.0	--
	%	7.1	30.1[c]	31.9[b]	27.4[b]	3.4	--
14	R	25.0[b]	71.0	14.0	39.5	12.0[b]	--
	E	26.3	74.7	14.7	41.6	12.6	--
	%	15.5	44.0	8.7	24.5	7.4	--
15	R	13.5	59.0	22.0	13.5	11.0	1.0
	E	17.4	76.1	28.4	17.4	14.2	1.3
	%	11.3	49.2	18.3	11.3	9.2	0.8
16	R	9.5	29.5	27.0	21.5	4.5	--
	E	15.6	48.5	44.4	35.3	7.4	--
	%	10.3	32.1	29.4	23.4	4.9	--
17	R	8.5	85.5	9.5	5.5	--	--
	E	12.4	125.1	13.9	8.0	--	--
	%	7.8	78.4[b]	8.7	5.1	--	--
18	R	3.5[c]	34.0	10.5	--[c]	--	--
	E	6.2	60.0	18.5	--[c]	--	--
	%	7.3	70.8	21.9	--[c]	--	--
19	R	11.5	33.0	32.0	3.0	0.5	--
	E	21.9	62.9	61.0	5.7	1.0	--
	%	14.4	41.3	60.0	3.8	0.6	--
20	R	9.0	26.0[c]	2.0[c]	4.5	9.0	1.0
	E	15.0	43.3[c]	3.3[c]	7.5	15.0[b]	1.7
	%	17.5	50.5	3.9[c]	8.7	17.5[b]	1.9
Total	R	11.4	59.4	20.7	17.2	4.1	0.4
	E	17.1	89.4	31.1	25.8	6.1	0.5
	%	10.0	52.6	18.3	15.2	3.6	0.3

A most obvious difference is the fact that 10.0 percent of the total behaviors for students were in category zero, unrelated behavior, the only category in which no teacher behaviors occurred. In comparing the other percentages one can see that students subsequently had fewer tallies in all of the other five behaviors. Category one seemed to be most affected with a difference between teachers and students of 6.5 percent. This is probably explained by remembering that one of the teaching activities in category one is that of providing information. Very often when this happens there is no verbal response by students; therefore, a tally in category zero is made. Other categories are assumed to be affected in the same way, with a teacher stimulation followed by an unrelated student response, usually silence.

There was great similarity between teachers and students in relation to the 20 classrooms which were at the top or the bottom of the ranges in any one of the categories of behavior. In fact, the differences were negligible. Teacher 1 and Students 1 were both at the top of the range for raw and equated frequencies in category one. The ranges in the data for Teachers 13 and 20 were similar to the ranges for the corresponding students in more than one category of behaviors. These similarities are related to the fact that the level of responses by students closely corresponded to the level of teacher stimulation. This is depicted very clearly by the matrices to be presented for answering the second question.

Behavior pairs

The number of tallies for each category of cognitive behavior was discussed in the two preceding tables. The mean frequencies for the total of all behavior pairs are presented in Table 7. The total number of behavior

Table 7. Raw and equated frequencies for the total number of cognitive pairs tallied for teachers and students

Classroom	R[a]	E[a]
1	169.5	199.4
2	104.5	187.2
3	59.5	137.3
4	132.0	205.7
5	100.5	165.2
6	197.0[b]	274.9[b]
7	107.5	172.0
8	97.5	182.8
9	136.5	157.5
10	106.0	161.0
11	99.0	125.1
12	98.5	173.8
13	189.5	261.4
14	161.5	170.0
15	120.0	154.8
16	92.0	151.2
17	109.0	159.5
18	48.0[c]	84.7[c]
19	80.0	152.4
20	51.5	85.8
Total	113.0	170.1

[a]R = raw frequencies, E = equated frequencies.

[b]High point of range.

[c]Low point of range.

pairs from the two class sessions for each teacher have been added together. From these sums the mean raw frequencies and the equated frequencies for the behavior pairs in each of the 20 classrooms have been calculated.

For the total number of behavior pairs tallied in the 20 classrooms, the mean number of pairs ranged from 48.0 in Classroom 18 to 197.0 in Classroom 6 with a mean for the total classrooms of 113.0 behavior pairs. When equated on the basis of time, the mean frequency for behavior pairs was

170.1 with a range of 84.7 for Classroom 18 to 274.9 for Classroom 6.

Classroom 18 was one of those in which one of the class sessions was not a teacher-pupil discussion. Only five behavior pairs were tallied for the second visit because students were giving group reports and the teacher was not entering into the discussion. In the first session for this classroom 91 behavior pairs were exhibited which is also quite far below the overall mean. No explanation for the large number of behavior pairs for Classroom 6 is evident from a study of the data.

Question Two

What relationships existed between the stimulation of cognitive behavior by teachers and the response by students in the selected ninth grade home economics classrooms as shown by application of the observational method? To answer the second question, data were recorded on matrices. Tallying of behaviors gave a teacher-pupil sequence which was repeated throughout an observation. The category for the teacher and for the pupil in each sequential pair of behaviors was used to enter the pair in a cell of a 6-row by 6-column matrix. A frequency count of behavior pairs for each of the 36 cells of the matrix was therefore obtained. The data for the cells of the matrices were converted to percentages but not to equated data.

Matrix cells

As one way of providing information about relationships existing between teachers and students in the cognitive domain the frequencies and percentages for the 36 behavior cells were studied. Matrices were obtained for the behaviors exhibited in each of the 20 classrooms. However, because of space limitations only the matrix for the total number of observations

is presented in this discussion. Table 8 shows the total raw frequencies and percentages for each of the 36 matrix cells as tallied during the 40 observations.

As discussed under Question One, no behaviors for teachers were tallied in category zero. This explains why the top row of cells of the matrix contains no behavior pairs. Except for the 0-0 cell, behavior pairs were

Table 8. Raw frequencies and percentages for the 36 matrix cells of cognitive interaction tallied for teachers and students in the total of all classrooms

Teacher categories*	Student categories* 0	1	2	3	4	5	Teacher total
0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
1	309 6.8	2340 51.8	8 0.2	13 0.3	0 0.0	0 0.0	2670 59.1
2	63 1.4	14 0.3	817 18.1	5 0.1	1 0.0	0 0.0	900 19.9
3	68 1.5	14 0.3	1 0.0	667 14.8	4 0.1	0 0.0	754 16.7
4	11 0.2	5 0.1	0 0.0	1 0.0	158 3.5	0 0.0	175 3.9
5	4 0.1	2 0.0	0 0.0	0 0.0	0 0.0	14 0.3	20 0.4
Student total	455 10.0	2375 52.6	826 18.3	686 15.2	163 3.6	14 0.3	4519

*Category zero = unrelated behavior;
category one = recall or obtain information;
category two = use or select and apply knowledge;
category three = analyze-compare-contrast;
category four = judge-evaluate-determine significance;
category five = generalize or create.

tallied with greatest frequency in the cells indicating teacher-pupil behavior at the same level. Behavior pairs which occurred with least frequency were those in the bottom row and in the right-hand column, all of which include a tally for category five in the cell.

The total number of tallies and percentages for each category of behavior for teachers were obtained by summing across the rows. For example, 2670 teacher behaviors were tallied in category one. This was 59.1 percent of the total, the same percentage appearing in Table 5. Summing down the columns gave the total number of tallies and percentages for each category of behavior for students. The grand total of 4519 indicates the total number of behavior pairs tallied in all 40 class sessions.

When percentages for the 36 cells of the matrices for each of the 20 classrooms were compared to the percentages for the 36 cells of the matrix in Table 8 it appeared that individual classrooms varied little from the total of all classrooms in the distribution among the cells. In other words, the percentage range among the 20 classrooms in any one of the 36 cells was small.

Matrix areas

In Table 9 the mean raw frequencies and percentages in each classroom for three matrix areas are presented. The matrix areas are: A, the diagonal area indicating a pupil response at the same level of cognitive behavior as the teacher stimulation; B, the area below the diagonal indicating a pupil response at a lower cognitive level than the teacher stimulation; C, the area above the diagonal indicating a pupil response at a higher cognitive level than the teacher stimulation.

Table 9. Raw frequencies and percentages for the three matrix areas of cognitive interaction tallied for teachers and students

Classroom	Area A[a]		Area B[a]		Area C[a]	
	R	%	R	%	R	%
1	147.0	86.7	22.5	13.3	--	--
2	101.0	96.7[b]	3.5[c]	3.4[c]	--	--
3	51.0	85.7	8.5	14.3	--	--
4	124.5	96.5	4.5	3.5	--	--
5	83.5	83.1	15.0	14.9	2.0	2.0
6	178.5[b]	90.6	18.0	9.1	0.5	0.3
7	95.5	88.8	9.5	8.8	2.5	2.3
8	75.5	77.4[c]	22.0	22.6[b]	--	--
9	123.0	90.1	13.5	9.9	--	--
10	100.0	94.3	4.5	4.3	1.5	1.4
11	92.5	93.4	4.5	4.6	2.0	2.0
12	96.0	88.5	12.5	11.5	--	--
13	172.0	90.8	15.5	8.2	2.0	1.0
14	135.0	83.6	26.0[b]	16.1	0.5	0.3
15	99.5	82.9	17.0	14.2	3.5[b]	2.9[b]
16	81.0	88.0	10.5	11.4	0.5	0.5
17	100.5	92.2	8.5	7.8	--	--
18	44.5	92.7	3.5[c]	7.3	--	--
19	67.0	83.8	13.0	16.2	--	--
20	40.5[c]	78.6	10.5	20.4	0.5	1.0
Total	99.9	88.5	12.3	10.8	0.8	0.7

[a]Area A, the diagonal, pupil response at same level as teacher stimulation.
Area B, below diagonal, pupil response at lower level than teacher stimulation.
Area C, above diagonal, pupil response at higher level than teacher stimulation.

[b]High point of range.

[c]Low point of range.

In Area A, the diagonal, the mean frequency of behavior pairs was 99.9 with a range of 40.5 to 178.5 behavior pairs. However, in percentages the range of 77.4 percent to 96.7 percent was very close to the 88.5 percent for the total of all observations.

In Area B, below the diagonal, the mean frequency was 12.3 with a range of 3.5 to 26.0. For all observations, 10.8 percent of the behavior pairs were in Area B of the matrix with a range among the classrooms of 3.4 percent to 22.6 percent.

Area C, above the diagonal, contained very few behavior pairs. The mean frequency was 0.8 with a range of 0.0 to 3.5. Only 0.7 percent of the behavior pairs were in this area with a range of 0.0 percent to 2.9 percent.

Similarity among classrooms for behavior pairs also appeared in the percentage data presented in Table 9. Although there were differences among the classrooms, these differences did not deviate extremely from the percentages for the total.

The most important conclusions made from an inspection of the data in Tables 8 and 9 concern relationships between teachers and students. Teacher stimulation and student response were most frequently at the same level of cognitive behavior. It would seem that, in the observations made, students were easily able to determine what was expected of them from the teacher's cues and to react accordingly. If students were not able to respond at the same level they would then most likely exhibit a behavior tallied in category zero as teacher stimulation at any level followed by student silence or unrelated response occurred in 10.0 percent of the matrix cells. Very rarely did students respond at a higher cognitive level than that stimulated by the teacher.

Question Three

Did the observational method, when applied in analyzing cognitive behaviors in the selected ninth grade home economics classrooms, discriminate among the 20 different classrooms on each of the six different cognitive behaviors and on the total of all cognitive behaviors for teachers and for students? To answer this question a single classification analysis of variance, fixed effects model, was computed using the raw and equated frequencies and the percentages for each of the categories of behavior. The analysis of variance among the 20 classrooms for the total number of behavior pairs was computed using raw frequencies and equated frequencies.

The F values from these analyses of variance are presented in Table 10. The observational instrument seemed to discriminate among the 20 classrooms for teachers' tallies in only one category of behavior. The F value of 4.18 based on the percentages for category four, judge-evaluate-determine significance, was significant at the .01 level. The F values in category four were not significant when based on raw or equated frequencies.

For students' tallies F values were obtained which indicated that the observational instrument seemed to discriminate in two categories of behavior; category zero, unrelated behavior, and category four, evaluate-judge-determine significance. In category zero the F value of 4.86 for raw frequencies was significant at the .01 level and the F values of 2.72 for equated frequencies and 2.44 for percentages were significant at the .05 level. In category four the only significant value was 3.01, based on percentages and significant at the .01 level.

Analyses of variance were also computed using raw and equated frequencies for the total number of behavior pairs exhibited in the 20 classrooms.

Table 10. F values from analysis of variance for the five behaviors for teachers, the six behaviors for students, and the total number of behavior pairs for each classroom

Behavior	F values		
	Raw frequencies	Equated frequencies	Percentages
Teacher			
1	1.73	1.09	1.46
2	1.66	1.36	1.34
3	1.37	1.26	1.60
4	1.01	0.98	4.18**
5	0.78	0.77	0.79
Student			
0	4.86**	2.72*	2.44*
1	1.65	1.07	1.46
2	1.55	1.40	1.33
3	1.39	1.37	1.71
4	0.94	0.99	3.01**
5	0.80	0.81	0.84
Total pairs	2.22*	1.64	

*$F_{.05}$ 19,20 d.f. = 2.13.

**$F_{.01}$ 19,20 d.f. = 2.95.

The F value of 2.22 based on the raw frequencies for the behavior pairs was significant at the .05 level. The F value was not significant at this level for behavior pairs when based on equated frequencies.

In studying the raw and equated frequencies and the percentages presented for teachers and students in Tables 5 and 6 it would seem that there was a significant variance among the 20 classrooms. However, a study of the teachers' percentages for each of the 40 class sessions separately (Appendix G) shows that there was also considerable variance between the two class sessions for each of the 20 classrooms. This lack of consistency between the two class sessions of each classroom on the number of behaviors exhibited in each category explains, at least in part, the lack of significant differences among the 20 classrooms.

At the present time the inability of the observational instrument to discriminate to a great degree among the 20 classrooms is not accepted as reflecting a weakness of the instrument. It may simply be reflecting an accurate picture of classroom behavior. Further research needs to be conducted to determine the optimum number of observations needed to more accurately describe a teacher's behavior patterns. The kind of teaching technique used needs to be more clearly defined to teachers for greater consistency among observations of the same teacher. If this further study of conditions necessary for the instrument to discriminate are successful and discriminability is determined, the instrument could then be applied in research studies where correlation with other measures of classroom behavior is desired.

Regardless of the ability of the instrument to discriminate among classrooms, usefulness of the instrument for describing cognitive behaviors

of teachers and students in home economics classrooms has been demonstrated. The five categories of cognitive behavior were found to exist in the classrooms observed and the instrument did indicate that different behavior patterns do exist among class sessions and among classrooms even though the differences among classrooms were not high. The instrument can be used by teachers and teacher educators in describing behaviors and can therefore also be valuable as a basis for efforts to improve teaching behavior.

RECOMMENDATIONS

Recommendations developing from this study are of two types. The first type are those recommendations for further refinement of the Brun Cognitive Interaction System (BCIS) and for further study of other data collected for the 20 classrooms that were not included in this report. The second type of recommendations meets one of the objectives of this research, to suggest ways of using the BCIS in teacher education activities at pre-service and in-service levels.

Future Research

Although one major revision of the Brun Cognitive Interaction System (BCIS) has occurred, this does not mean that further refinement is not needed. It is suggested that the definitions for the categories be studied and refined by others as rewording would probably increase their clarity to others. Category zero for teachers might be deleted as it was so rarely used. Some of the categories could be divided into two or more new categories, depending upon the purposes for which the BCIS is used. For example, in category one it might be helpful to know whether a teacher is stimulating the recall of information or the obtaining of new information.

Different tallying procedures and different ways of presenting the data could be investigated. In the second phase of the research, data for both teachers and students were not studied using one of the composite analysis sheets developed in the first phase of the research. This analysis sheet showing the flow of cognitive behaviors in graph form could be adapted in presenting both teachers' and students' behaviors for certain analytical purposes.

The strongest recommendation to be made concerning the present form of the BCIS is that the examples of behaviors illustrating the categories and tallying procedures be revised. It is not recommended that examples of teacher-student interaction be original to the writer as this technique used in the first phase of the research did not seem to lead to examples of behaviors which are really typical of classroom interaction. However, through observation of more classrooms, either live or recorded, better examples of illustrative interaction can certainly be found.

Further research concerning the ability of the BCIS to discriminate among classrooms is needed. The optimum number of observations for more accurately describing a teacher's patterns of classroom behavior requires investigation. Another study using this system should be designed to at least include more than two observations in any one classroom. The teaching technique to be observed should be more clearly defined for the teacher.

The BCIS only provides for categorizing verbal behaviors with the exception of category zero. Future research using the system might therefore be conducted using less costly audiotapes instead of videotapes.

The videotapes made of behaviors in the 20 selected classrooms were also used in research conducted by Zimmerman (1970) and Adams (1970). Information collected by Zimmerman on the 20 classrooms includes: 1) the teachers' scores on the Personal Orientation Inventory, an instrument thought to measure an individual's degree of self-actualization; 2) certain kinds of demographic information about the teachers' educational, professional, and family background; 3) the results of students' responses to the Homemaking I form of the Student's Estimate of Teacher Concern, specifically titled How a Teacher Works With Students; and 4) data about classroom

interaction in the affective domain as collected by analyzing behaviors on the videotapes using the Sequential Analysis of Verbal Interaction system (Simon and Boyer, 1968). Adams, following up research conducted by Kalbfleisch (1967), applied the Verbal Interaction Category System (Amidon and Hunter, 1967), which also analyzes behaviors classified in the affective domain, in tallying behaviors on the videotapes. Both Zimmerman and Adams conducted statistical analyses of their data by studying differences between those 10 teachers who received the highest scores and those 10 who received the lowest scores on the Personal Orientation Inventory.

The data collected on the 20 classrooms using the BCIS could also be studied for differences in performances based on the Personal Orientation Inventory scores and on other data collected by Adams and Zimmerman. Although the BCIS did not discriminate among teachers except in one category, the other data available might be studied in correlation with cognitive behaviors to see if any trends were evident which could suggest hypotheses for further investigation.

Application in Teacher Education

The study demonstrated that the Brun Cognitive Interaction System (BCIS) was appropriate for home economics classrooms. There were a variety of cognitive behaviors occurring which could be analyzed by the system. The second purpose of the research, to suggest applications of the BCIS in teacher education at pre-service and in-service levels, could therefore be met.

The BCIS does not identify good and bad teaching. In all uses of the system the objectives of the research or the teaching must form the basis

for evaluating data collected. Although the need for developing skills at the higher cognitive levels has been stressed, it is also acknowledged that knowledge is necessary to provide the basic material for operating at all the higher levels.

The primary values of any observational system to teachers are as a means for helping them to develop a more accurate concept of teaching behavior and for assessing their own teaching and that of others more objectively. Both home economics education undergraduates and experienced teachers can profit from an introduction to the BCIS. It can provide one kind of framework for organizing teaching behaviors into a workable number of concepts. From there teachers can better plan their teaching behaviors to meet certain objectives.

An introduction to the BCIS might come during formal course work, conferences, workshops, or the student teaching experience. The length of time needed to become familiar with the system will depend on the purposes for which it will be used. The learning of the BCIS, which contains only six different categories of behavior, does not require a length of time as long as that for more complex analysis systems.

Supervising teachers and college supervisors of student teachers are another group of home economics educators who could use the BCIS. They could use the recorded data as one way of communicating to the student teachers what they observed.

Many observational systems, including the one developed in this research, treat the students as a group when in actuality the behavior exhibited by one student should not be treated as an index of what is happening to every other student. It is therefore recommended that a teacher could

use the BCIS in viewing videotapes of her class sessions but extend the analysis of the student behaviors to identify which of her students is responding. This could provide more accurate quantitative information concerning which students dominate in the classroom interaction and which students rarely respond.

An observational system for analyzing cognitive behaviors can be used for building curriculum. Teachers can use the categories of behavior in the BCIS for planning activities and teaching behaviors which will develop cognitive skills in pupils at more than the memory level. They can, in turn, use the categories as a basis for describing the success of their efforts as recorded on audiotape or videotape.

SUMMARY

The primary purpose of this study was to develop and test a method for observing and recording classroom interaction between teachers and students. A secondary purpose of the study was to suggest ways of applying the observational and recording method in teacher education activities at pre-service and in-service levels.

Specific objectives for achieving the purposes of the research were to:

A. Develop an observational instrument for analyzing teaching behaviors that stimulate student cognitive processes and the responses of students to these teaching behaviors.

B. Test the observational instrument for analyzing teacher-student cognitive interaction occurring in classrooms in three ways:

1. Study inter-observer and intra-observer reliability.
2. Categorize cognitive behaviors in home economics classrooms as displayed on videotapes.
3. Study the data supplied by the tallying of behaviors to determine:
   a) frequencies for the six levels of cognitive behaviors and for the total of all cognitive behaviors;
   b) relationships between behaviors of teachers and students;
   c) ability of the method to discriminate among classrooms on each of the six different cognitive behaviors and on the total of all cognitive behaviors for teachers and for students.

Two areas of educational concern provided justification for the re-

search. The first of these was a need for a better understanding of general teaching-learning processes so that the education of teachers and actual teaching might be more effective. The second of these was a need for a better understanding of specific teaching-learning processes in the cognitive domain. Researchers found that teachers stimulated a disproportionate number of lower level cognitive behaviors in the classroom, ignoring those skills needed for students to be able to develop concepts and form generalizations. Many observational systems that recorded behaviors in the cognitive domain noted only their general occurrence and failed to analyze the structure or quality of the behaviors in this domain. The theory of cognitive behavior had only recently been sufficiently developed to provide a basis for research in instrument development. Because of these needs and conditions the research reported here was designed.

The first phase of the research concentrated only on the teaching behaviors that stimulated student cognitive responses. A review of the literature was made to identify theoretical structures and to provide background for instrument development. A research team viewed films and videotapes made of teacher-pupil behaviors in classrooms and identified cognitive behaviors they were observing. A preliminary observational instrument containing five categories of behavior and their definitions was developed and refined. Techniques for using the instrument to observe and record cognitive behaviors were developed and research team members were prepared for making the analysis of these five categories of behaviors as they were exhibited in the classroom. Videotapes were made of home economics class sessions and were analyzed by three members of the research team using the observation instrument. Chi-square analyses were made of observational

data to study inter-observer reliability.

In the second phase of the research the observational instrument was extended to include categories for analyzing responses which students made to the stimulation of cognitive processes by teachers. A major revision of all parts of the instrument was made as problems were discovered when applying the instrument in analyzing classroom behaviors. The categories of behavior for teachers and for students were given corresponding titles: a) category zero, unrelated behavior; b) category one, recall or obtain information; c) category two, use or select and apply knowledge; d) category three, analyze-compare-contrast; e) category four, judge-evaluate-determine significance; f) category five, generalize or create. Directions for using the instrument were developed, a form for recording behaviors was designed, and examples of classroom behaviors illustrating the categories and the directions were taken from videotapes of actual home economics class sessions. The instrument was named the Brun Cognitive Interaction System (BCIS).

As a result of non-significant chi-square analyses based on tallies made by observers applying the BCIS in viewing classroom behaviors exhibited on videotapes and typescripts, both inter-observer and intra-observer reliability were established for the investigator. The BCIS was further tested in tallying behaviors occurring in home economics classrooms. Videotapes were made of one of the ninth grade classrooms of 20 selected home economics teachers in Iowa on two different days when teacher-student discussion was the teaching technique used. The behaviors as exhibited on these videotapes were then analyzed and recorded by the investigator using the BCIS. The data supplied by the tallying of behaviors were studied concerning the

frequencies for the six levels and totals of cognitive behaviors, the relationships between behaviors of teachers and students, and the ability of the system to discriminate among classrooms.

A study of the data showed that behaviors for teachers were tallied in all categories of cognitive stimulation except category zero, unrelated behavior, and that behaviors for students were tallied in all categories. However, as the level of cognitive behavior increased the number of classrooms exhibiting the behavior decreased. Only nine teachers and seven groups of students exhibited behaviors tallied in category five, generalize or create. Also, as cognitive level increased the number of tallies at each level of behavior decreased very rapidly. For both teachers and students over 50 percent of all tallies were in category one, less than 20 percent were in category two and again in category three, less than 4 percent were in category four and 0.3 to 0.4 percent of the tallies were in category five. No classroom which failed to receive tallies at one level received tallies at a higher level of behavior. These findings provided evidence that a hierarchy of behaviors existed.

The position of a teacher or group of students in the range for one category of behavior affected the position in the range for other categories. If many behaviors were exhibited in any one category there was a tendency that the likelihood of using other categories was reduced.

The data for the 20 groups of students and the 20 teachers showed very similar patterns. The tallies in category zero for students meant that fewer tallies appeared for students in all of the other five categories but there was otherwise a close and positive relationship between the levels of cognitive behavior stimulated by teachers and that which students exhibited

in response. This was especially evident when a matrix was presented indicating the frequencies and percentages for the 36 possible combinations of teacher-student behavior pairs. In the diagonal area of the matrix, which indicated a student response at the same level of cognitive behavior as the teacher stimulation, 88.4 percent of the tallies occurred. Tallies occurred 10.9 percent of the time in the area below the diagonal indicating a student response at a lower level than the teacher stimulation, this student response usually being in category zero. In only 0.7 percent of the cases did tallies occur which indicated a student response at a higher level than the teacher stimulation.

With a few exceptions the BCIS did not discriminate among the 20 classrooms. Groups of students did differ in the use of category zero. Both students and teachers differed in category four only when the analysis was based on percentages. In all other categories for teachers and students there were no significant differences among the 20 classrooms. A partial explanation for this was the lack of consistency between the two class sessions of each classroom on the levels of behaviors exhibited. The inability of the BCIS to discriminate among classrooms was not accepted at the present time as a weakness of the system but further research was suggested.

The usefulness of the BCIS for describing cognitive behaviors of teachers and students in home economics classrooms as a basis for efforts to improve teaching behavior was demonstrated. Recommendations for using the system in further research and in teacher education were made.

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APPENDIX A. CATEGORY SYSTEM FOR ANALYZING TEACHING BEHAVIORS

I. RECALL

To bring to the conscious level that information which is stored in the mind or can be obtained through the senses. Here, the concern is for the observable, tangible, obtainable, concrete. Who, where, what, when might be used.

Examples:

"How many primary colors are there?"

"Jane, by looking at the pattern chart, tell us the amount of material you will need for making View A?"

"All of you write down three kinds of credit."

"What is the recommended oven temperature for dry roasting meat?"

"Sue, give us the name of two fabrics that have nap."

"What are the reasons for a monthly medical exam during pregnancy?"

"What do you see on my desk?"

"Who won the basketball game last night?"

"How did you get to school today?"

"Feel this material (velvet). Does this fabric have nap?"

II. USE OR SELECT AND APPLY KNOWLEDGE

To utilize or put into practice information or knowledge; bring to bear appropriate facts, generations or principles. This may occur in two different ways: (1) the teacher indicates knowledge which the learner is then to apply or (2) the learner selects the knowledge which he is then to apply.

Examples:

"Today in lab I'd like you to use the information you obtained from your reading assignment and from the demonstration to prepare deep fried French fries."

"Diane, can you please explain the reasons for the placement of these three pattern pieces onto this length of corduroy as you are doing it?"

"Why would you or would you not criticize a child for scribbling on his drawing paper?"

"Which kind of credit would you select if you were buying a house?"

"How would you change the arrangement of this kitchen to make it more convenient?

"How might you later be able to use the experiences you had this summer in your baby-sitting job?"

III. ANALYZE, COMPARE, CONTRAST

To separate material or information so that the constituent parts of the characteristics are apparent. To detect the similarities and/or differences involved. To analyze on the basis of known categories or systems.

Examples:

"In what way is the color orange like the color green?"

"Why are vitamins and minerals sometimes called regulatory nutrients?

"What part of this advertisement would influence your decision?"

"How are the meal patterns of Japan and the United States different?"

"What would you have to assume before you could accept the statement about the influence of income on health as true?"

"Now that we have toured the supermarket, write four rules that would help someone in organizing her grocery shopping."

"Choose the best of these three materials for the above dress. In relation to your own personal coloring and figure, justify your choice."

"Using the categories of plain, twill, and satin weave, divide your 13 fabric swatches into the appropriate three piles."

IV. JUDGE, EVALUATE, DEFINE SIGNIFICANCE

Judge products, methods or ideas according to identifiable criteria. Answers are extended beyond one or two words to explain the reason for the decision or judgment.

Example:

"How would this idea of yoursaffect society?"

"Judge the quality of these plans for storage according to what we've said about useful and efficient storage."

"Who do you believe should make the major decisions in the family? Why?"

"Tell me why you believe you should support this theory of child discipline."

"What factors would be most important to consider in making a decision about a marriage partner? Why are they so important to you?"

"In the short 'Case' just read, were the mother's actions effective in guiding her child? How might this action affect the child?"

"Which of these two methods of inserting a zipper is best? On what basis do you make this statement?"

V. CREATE

Put together the parts into a whole that is meaningful or into a principle that covers similar situations or circumstances. This area implies originality; something the student has not seen or done before. It includes generalizing and synthesizing.

"We have now studied intellectual development of children at two different age levels. What principles of child-rearing practices would apply to both of these levels?"

"We have studied cheese, egg and milk cookery separately. Can you think of statements that would apply to cookery of each of these foods?"

"Yesterday we heard a discussion about care of the aging, we've visited a nursing home, and you interviewed an elderly person. Now, write a paper telling how you would care for an aging relative in your own particular family situation."

"Using the principles of kitchen planning as a guide, I would like you to design a kitchen floor plan that you would like to have in your dream home."

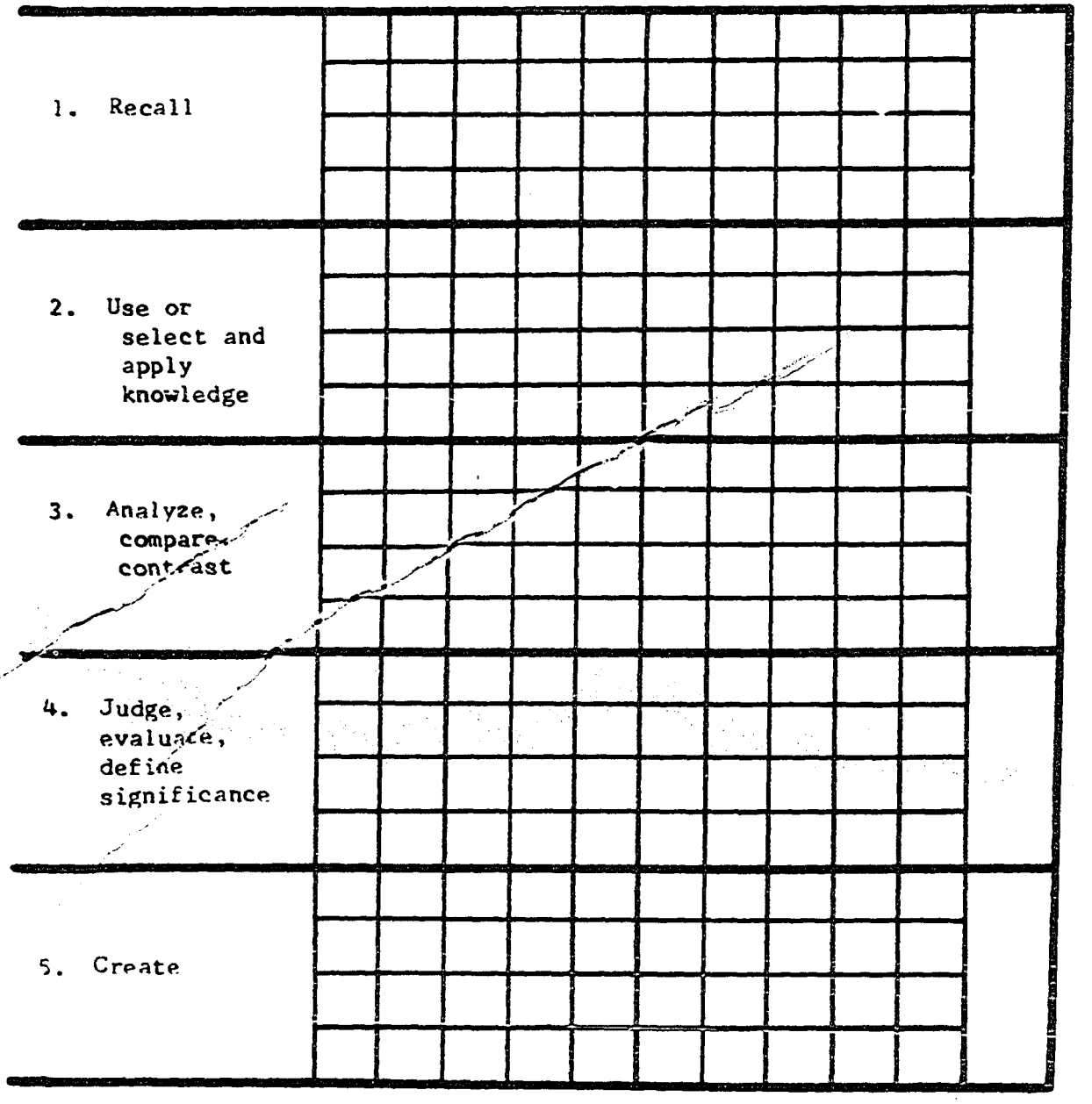
"Here are some eggs of different ages. Examine them and develop a set of four rules for describing fresh eggs."

APPENDIX B. SAMPLE TALLY SHEET FOR TEACHING BEHAVIORS

TEACHER BEHAVIOR TALLY SHEET

DIRECTIONS: Record the level of cognitive process you would expect students to exhibit as a result of behavior used by the teacher. Record a tally for each behavior by using a "1" for the first behavior, a "2" for the next, etc.

Teacher _____
Observer _____
Date _____ School _____
Topic _____
Grade _____ No. students _____
Tape No. _____



APPENDIX C. COMPOSITE ANALYSIS SHEET I

COMPOSITE ANALYSIS SHEET 1

Teacher _____ Lesson Topic _____

Taping Date _____ No. students _____

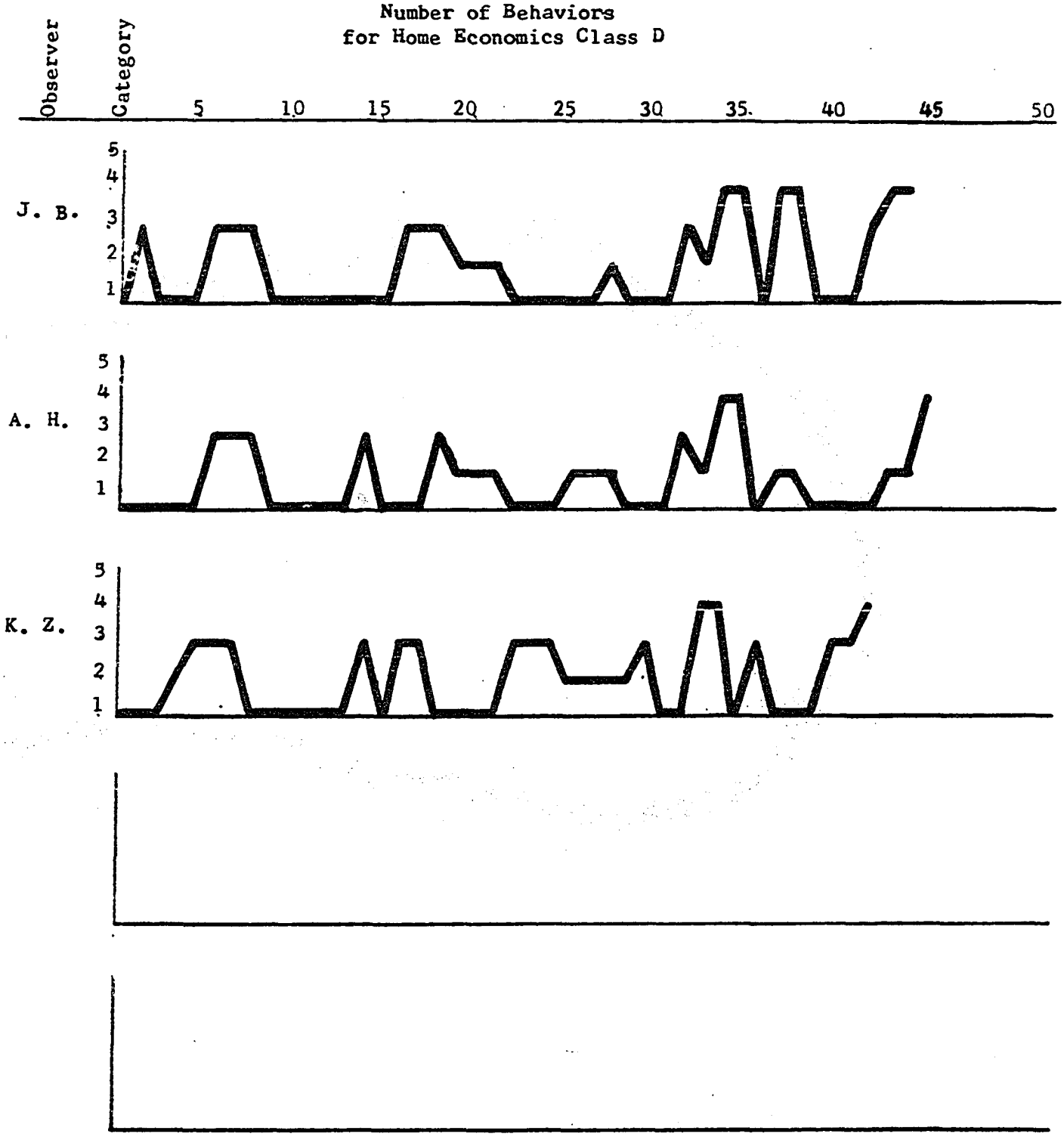
School _____ Grade _____

Tape No. _____ Listening time _____

Observer	Category					Total
	1	2	3	4	5	
J. B.	23	5	10	6	0	44
A. H.	21	7	12	4	0	44
K. Z.	20	5	13	3	0	41

APPENDIX D. COMPOSITE ANALYSIS SHEET II

COMPOSITE ANALYSIS SHEET 2



APPENDIX E. CATEGORY SYSTEM FOR ANALYZING STUDENT BEHAVIORS

STUDENT RESPONSE CATEGORIES

0. No response

The student responds in one of the following ways: a) silence, b) unrelated verbal response, c) by stating he doesn't know, d) by stating he couldn't hear.

1. Recall

The student responds with information which is stored in the mind or can be obtained through the senses. This would include facts and ideas previously discussed in class. It would also include observations and perceptions the student could experience through the senses of sight, smell, touch, taste and sound. The concern is with what is known and with what can easily and quickly be known without using higher mental processes.

2. Use or select and apply knowledge

The student utilizes or puts into practice information or knowledge which he can recall,; which is stored in the mind or can be obtained through the senses. He brings facts, generalizations, principles, observations and ideas to bear upon the appropriate situations. This may occur in two different ways: (1) the teacher may indicate the knowledge which the student is then to appropriately apply or (2) the student is expected to select the relevant knowledge and then to appropriately apply it.

3. Analyze, compare, contrast

The student separates material, information and ideas so that the constituent parts or the component characteristics are apparent. He might also compare or contrast constituent parts which he has separated by

analysis to detect the similarities and/or differences involved. Analysis at this level is based on known categories or systems and not on categories or systems the student himself creates.

4. Judge, evaluate, define significance

The student judges material, information, products, methods and ideas according to criteria that are identifiable by him. This implies that his answers or responses are extended beyond one or two words to explain the reasons for his decision or judgment. If he does not do this or the teacher does not prompt him to justify his judgment, the response is assumed to be at the recall level where rote memory has made it possible for him to answer.

5. Create

The student responds at a high cognitive level by putting parts or components together to form a whole that is meaningful or to synthesize a principle or generalization that covers similar situations or circumstances. The student response is original; something the student has not seen, done, said, or created before.

JB:12/69
First draft

APPENDIX F. SAMPLE TALLY SHEET FOR TEACHER-STUDENT BEHAVIORS

Teacher _____ Session _____ ANALYSIS OF COGNITIVE PROCESSES 4/70

Card 01		Card 02133		Card 03	
T	S	T	S	T	S
1)		1)		1)	
2)		2)		2)	
3)		3)		3)	
4)		4)		4)	
5)		5)		5)	
6)		6)		6)	
7)		7)		7)	
8)		8)		8)	
9)		9)		9)	
10)		10)		10)	
11)		11)		11)	
12)		12)		12)	
13)		13)		13)	
14)		14)		14)	
15)		15)		15)	
16)		16)		16)	
17)		17)		17)	
18)		18)		18)	
19)		19)		19)	
20)		20)		20)	
21)		21)		21)	
22)		22)		22)	
23)		23)		23)	
24)		24)		24)	
25)		25)		25)	
26)		26)		26)	
27)		27)		27)	
28)		28)		28)	
29)		29)		29)	
30)		30)		30)	
31)		31)		31)	
32)		32)		32)	
33)		33)		33)	
34)		34)		34)	
35)		35)		35)	

APPENDIX G. TEACHER PERCENTAGES FOR CLASS SESSIONS

Table 11. Percentages for the five cognitive behaviors tallied for teachers in each class session

Teacher	Session	Category of Behavior				
		1	2	3	4	5
1	a	84.7	9.7	5.6	--	--
	b	88.1	11.9	--	--	--
2	a	81.7	4.4	12.2	1.7	--
	b	30.9	45.7	21.3	1.1	1.1
3	a	70.0	20.0	4.3	5.7	--
	b	91.8	8.2	--	--	--
4	a	79.0	21.0	--	--	--
	b	57.1	30.0	10.7	2.1	--
5	a	86.7	13.3	--	--	--
	b	36.0	20.7	36.9	1.8	4.5
6	a	80.1	10.7	8.7	0.5	--
	b	30.3	35.1	31.4	2.1	1.1
7	a	37.8	33.3	17.1	11.7	--
	b	51.0	4.8	33.7	4.8	5.8
8	a	71.7	6.5	13.0	8.7	--
	b	55.3	19.4	25.2	--	--
9	a	56.4	14.7	17.3	11.5	--
	b	76.1	7.7	14.5	0.9	0.9
10	a	58.1	13.7	25.8	2.4	--
	b	71.6	10.2	14.8	2.3	1.1
11	a	23.4	28.6	45.5	2.6	--
	b	52.1	25.6	16.5	5.8	--
12	a	83.2	2.1	14.7	--	--
	b	48.0	38.2	11.8	2.0	--
13	a	53.3	30.7	16.0	--	--
	b	21.4	36.2	36.7	5.7	--
14	a	66.0	16.0	17.0	1.0	--
	b	45.4	7.9	34.9	11.8	--
15	a	53.2	25.3	10.8	10.8	--
	b	62.2	17.1	9.8	8.5	2.4

Table 11. (Continued)

Teacher	Session	Category of Behavior				
		1	2	3	4	5
16	a	34.2	38.0	26.6	1.3	--
	b	44.8	24.8	23.8	6.7	--
17	a	98.2	1.8	--	--	--
	b	82.2	11.0	6.8	--	--
18	a	76.9	23.1	--	--	--
	b	100.0	--	--	--	--
19	a	48.2	43.4	8.4	--	--
	b	48.1	44.2	5.2	2.6	--
20	a	59.3	--	7.4	25.9	7.4
	b	57.9	6.6	15.8	19.7	--